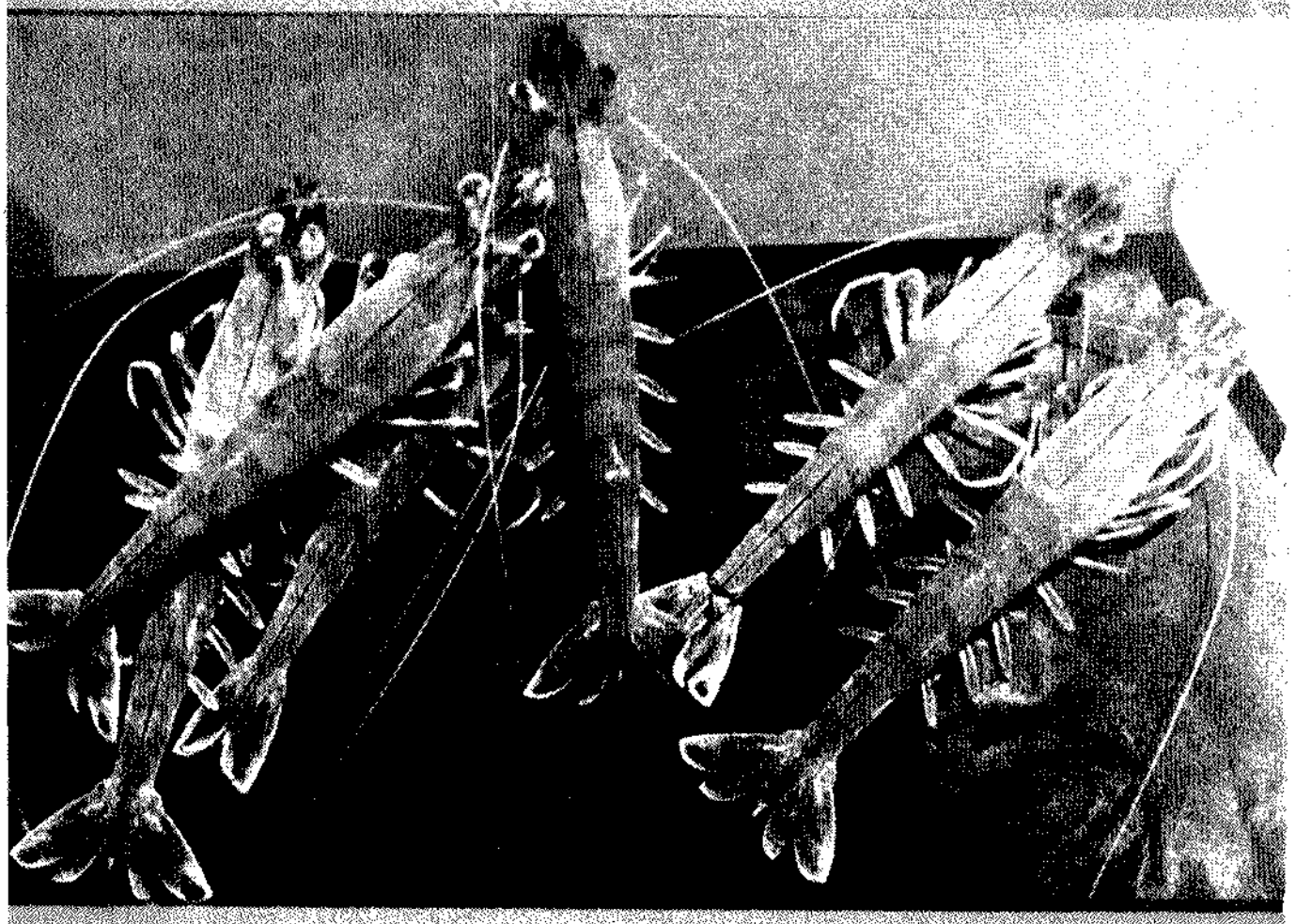
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN

ANNUAL REPORT 1986-87



INDIAN COUNCIL OF AGRICULTURAL RESEARCH

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RESEARCH INSTITUTE
COCHIN

ANNUAL REPORT
1986 - 87

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

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ANNUAL REPORT (1986-'87)

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INTRODUCTION

The Central Marine Fisheries Research Institute was established in 1947 by the Ministry of Agriculture and Irrigation and subsequently brought under the ICAR in 1967. The Institute has its headquarters at Cochin. The Regional Centre of the Institute is located at Mandapam Camp and its 11 Research Centres and 29 Field Centres are situated along the east and west coasts of the country. Experimental Stations and field facilities located at Tuticorin, Kovalam/Muttukadu, Mandapam Camp and Calicut are attached to the respective Centres.

The Institute has the mandate to conduct research for assessing and monitoring the exploited marine fisheries resources leading to rational exploitation and conservation; to assess the underexploited and unexploited marine fisheries resources of the Exclusive Economic Zone; to understand the fluctuations in abundance of marine fisheries resources in relation to changes in the environment by conducting vessel-based programmes; to develop suitable mariculture technologies for finfish and shellfish in open sea to supplement marine fish production; to conduct transfer of technology and post-graduate and specialised short-term training programmes.

The research programmes of the Institute are implemented through the following 9 major Divisions.

1. Fishery Resources Assessment Division
2. Pelagic Fisheries Division
3. Demersal Fisheries Division
4. Crustacean Fisheries Division
5. Molluscan Fisheries Division
6. Fisheries Environment Management Division
7. Physiology, Nutrition and Pathology Division
8. Fishery Economics and Extension Division
9. Library and Documentation Division

The Post-graduate Programme in Mariculture affiliated to the Cochin University of Science and Technology conducts M.Sc. and Ph.D. programmes in Mariculture. The Krishi Vigyan Kendra and Trainers' Training Centre at Narakkal are concerned with extension programmes and imparting training in prawn and fish culture.

Physical target achievements:

After moving into the permanent headquarters and laboratory building at Cochin, the facilities for the different Divisions were strengthened. Action was taken to establish laborato-

ries for specialised areas of research. Necessary steps were taken to acquire land for laboratory building, residential quarters at Cochin, Veraval and Kakinada. A total of Rs. 46 lakhs were spent for the purpose. The actual expenditure incurred during the year for all activities was Rs. 311.69 lakhs (Non-Plan) and Rs. 80.01 lakhs (Plan).

Marine fish production :

Estimates on an all India basis indicated a production of 1.720 million tonnes during 1986, a 12.2% increase over that of 1985. The bumper catch of carangids (144700 t) mainly from Kerala and Karnataka and the high landings of 23841 t of mackerel from Andhra Pradesh hiked the total catch. The slump in oil sardine and Bombay duck catches was more than adequately compensated by carangids, anchovies, perches, mackerels, silver bellies, penaeid prawns and ribbon fish.

Pelagic resources :

Tuna production increased from 30722 t in 1985 to 34057 t in 1986. Studies indicated possibilities of increasing yields of the little tunny *Euthynnus affinis* at Calicut, Cochin and Tuticorin; frigate tuna *Auxis thazard* at Tuticorin and skipjack tuna *Katsuwonus pelamis* at Minicoy.

The oil sardine landings in 1986 fell by about 35% when compared to that of the previous year. Investigations on stocks of oil sardine at Cochin based on data for the period 1980-85 showed that further increase in effort by purse seines is not likely to increase the yield significantly. The general decline in mackerel catch was accompanied by an unusually high 23841 t in Andhra Pradesh.

Demersal resources :

A marginal increase was noticed in the catches of sciaenids and perches while it was substantial with the threadfin breams. Catfish landings declined. A disquieting feature associated with the catfish fishery for many years has been the destruction of egg incubating males and juveniles of catfish in purse seine operations. This may be one of the causes for the failure of the catfish fishery at some centres along the west coast.

Crustacean resources :

Data from trawl operation on the North-East coast from the Visakhapatnam base indicated that the prawn resources in the area could sustain only 105 trawlers (23 m). The present strength of 118 trawlers could lead to diminishing returns. Studies on stock assessment have shown that in Kakinada there is a possibility of increasing yield with more effort. The capture of juveniles of *Penaeus semisulcatus* from Palk Bay and its possible detrimental effect on the marine fishery deserves special attention.

Molluscan resources :

Cephalopod production, particularly that of *Sepia pharaonis* noticeably increased during the year. During vessel based surveys significant collections of *Symplectoteuthis oulaniensis* were made off the Bombay-Okha region at a depth of 40-250 m. Chanks

were tagged and released in beds off Tuticorin for further studies. Egg capsules of chank were kept alive at Tuticorin for observing the development of fertilized eggs. Baby chanks were released off Tuticorin after a period of 45 days in one capsule.

Environmental studies :

Drift bottles were systematically released from different centres to study coastal currents which aid migration of prawns and fishes. The bottles recovered showed a southward drift along the east and west coasts during February-March. The recovery of bottles from the Sri Lanka and Somali coasts is noteworthy.

Physiology, Nutrition, Pathology and Genetics studies :

Mugil cephalus was induced to mature and spawn through salinity manipulation and administration of hormones. About 5 lakh larvae were produced. Experiments on osmoregulation in *Penaeus indicus* indicated the involvement of 'eyestalk' factors in the control of osmotic concentration of haemolymph of *P. monodon*. The lustre and colour of nacre of *Crassostrea madrasensis* developed rosy discolouration when 3-5 mm spat were fed with *Isochrysis galbana* with a suspension of ferrous citrate @ 8 nanograms per litre.

Nutrition experiments on milkfish fry indicated a preference for diet containing sardine oil and groundnut oil with protein, carbohydrate, lipid, vitamin mix and mineral mix at percentage levels of 40, 45, 6, 1 and 3 respectively with gelatin as binder. *P. indicus* were experimented on to study the effect of food additives and flavouring agents on the test animals. *P. indicus* fed with diet containing glycine registered better food conversion and growth rate .

Investigations on soft prawns revealed that the occurrence of 'soft' condition increased with increase in the oxidation-reduction potential of the pond bottom (beyond — 250). It was seen that once the soft condition set in there was no improvement even when pond bottom conditions improved.

Tissue specific expression of proteins was determined in four tissues of *Crassostrea madrasensis*. A genetically variable protein loci was identified in the adductor muscle of *C. madrasensis* populations from Cochin and Tuticorin.

Fishery economics :

Case studies of mechanised units at Sakthikulangara indicated that the average gross income per fishing day for trawler was around Rs. 1,200 and for a gill netter Rs. 950. The average net income per day for two types of units were Rs. 220 and Rs. 200 respectively.

An analysis of fish marketing in the Madras region showed that the fisherman's share in the consumer's rupee ranged from 20 paise for rays to 75 paise for seerfish and pomfret. The fisherman's share of consumer price was directly correlated to the degree of consumer preference.

Cost and returns of dol net operations were examined in Maharashtra and Gujarat. The variable cost per operating day of the *Khamba* system was Rs. 324 and that of the *Sus* system Rs. 450. The average profit ranged from Rs. 75-88 per operating day.

Mariculture :

A major breakthrough was achieved in the domestication of *Penaeus latisulcatus*. This new candidate species was grown at the Institute's farm at Muttukadu (Madras) to adult size, induced to mature and spawn in captivity. The larvae were successfully grown for stocking in ponds. *Penaeus canaliculatus* was identified as another potential species for culture. A trial hatchery at Mopla Bay for prawn seed production was highly successful.

Pearl oyster culture programmes continued at Tuticorin. Pearl oyster spat *(Pinctada fucata)* was supplied to Lakshadweep in October 1986 at a mean size of 13.2 mm. They grew to 29.1 mm in Bangaram and 22.9 mm in Agatti by mid-February 1987. In the hatchery production programme of *Crassostrea madrasensis*, 14 batches spawned and seed obtained from 8. Breeding and rearing of the black lipped pearl *Pinctada margaritifera* was achieved and about 48800 spat produced.

In finfish culture experiments the accent had been on new species like *Lates calcarifer, Epinephelus* spp. and *Sillago* spp. Attempts were also made to raise broodfish from pond grown grey mullets.

Vessel based research programmes :

During the year FORV *Sagar Sampada* made 15 research cruise and logged 210 days at sea. She surveyed a total area of 1305440 sq. nautical miles in the EEZ including Lakshadweep and Andamans. For the first time *Sagar Sampada* undertook a cruise in April 1986 around the Andaman and Nicobar Islands covering 41 stations. The results indicated that Andaman waters were rich in oceanic squids. Large concentrations of threadfin bream, cuttlefish and squids were located in the Wadge Bank. The research facilities of *Sagar Sampada* were availed of by the scientists from various laboratories, Institutes and Universities in the country.

R. V. *Skipjack* monitored environmental parameters along the south-west coast and also studied the seasonal and depth wise distribution of prawns off Cochin. The prawns were found to migrate to deeper waters during the south-west monsoon. The *Cadalmins* at the different centres provided support to the various research programmes.

Education, Training and Transfer of Technology :

During the year, under the Post-graduate Programme in Mariculture seven out of eight junior research fellows (fifth batch) passed the M.Sc. examination in First Class. 18 candidates

of the sixth and seventh batches underwent the course. Three senior research fellows were awarded the Ph.D. degree by the Cochin University of Science and Technology. Four others submitted their Ph.D. theses. Under the consultancy programme, Prof. Milton Fingerman, Tulane University, USA provided consultancy in fish and shellfish endocrinology. Dr. D. J. M. Moriarty of CSIRO, Australia visited the Institute as a consultant in microbial ecology. Two scientists of CMFRI received specialised training abroad under the training programme for faculty members.

The Krishi Vigyan Kendra conducted 57 training courses and trained 822 farm women and 321 farm men. The Trainers' Training Centre organised training courses in different aspects of mariculture with the involvement of subject matter specialists of the Institute.

In conclusion I must add that the overall progress of the Institute's programmes has been very satisfactory. The programmes will be further strengthened.

The details of project-wise progress are presented under the different Divisions.

Dr. P. S. B. R. JAMES
Director

GENERAL INFORMATION

Engagements

Dr. P. S. B. R. James, Director, CMFRI attended the following :

World Conference on Trade in Frog legs vis-a-vis Environmental Considerations, organised by MPEDA and CIFRI. Calcutta, 10-11 April.

Seminar on futurology on the theme 'Towards the 21st Century'. Trivandrum, 3 May.

Meeting of the Standing Committee, Ministry of Agriculture, to coordinate the functions of fisheries institutes. New Delhi, 28 May.

Meeting of the Project Implementation Committee pertaining to the EFC memo of CMFRI. New Delhi, 11 June.

The Second National Fish Seed Congress. Calcutta, 3 July.

ICAR Regional Committee (No. 8) Meeting at IIHR. Bangalore, 17-18 July.

Futurology Workshop to identify the Science and Technology input for Lakshadweep upto 2005 A.D. at RRL. Trivandrum, 21-22 July.

ICAR Scientific Panel Meeting. New Delhi, 6-7 November.

ICAR Meeting convened by the DDG(F) pertaining to the 6th and 7th Plans. New Delhi, 12-13 January.

MPEDA meeting. Madras, 12 February.

ICAR Governing Body meeting. New Delhi, 13 March.

Dr. P. S. B. R. James served as : Hon. Vice President, Institute of Fish and Nutrition (Indian Federation of U.N. Associations), New Delhi.

Member of High Power Committee on Management of Marine Fishery Resources, Ministry of Agriculture.

ICAR representative in the Academic Council, Cochin University of Science and Technology.

Convenor, AFDC Panel for Fish Seed of the ISI, New Delhi.

Member, Board of Studies in Industrial Fisheries, Cochin University of Science and Technology.

Chairman, Board of Studies in Mariculture, Cochin University of Science and Technology.

Dr. K. Radhakrishna, Scientist S-3 and **Shri G. Sudhakara Rao,** Scientist S-2 attended the Technical Committee meeting of the FSI on Factual Position of Prawns. New Delhi, 9 April.

Shri B. S. Ramachandrudu, Farm Engineer attended the Workshop on Sedimentation Problems in Coastal Aquaculture Farm Planning, 12-13 February.

Dr. G. Luther, Scientist S-3 attended the meeting of the Consultative Group of Visakhapatnam Base of FSI. Visakhapatnam, 30 April.

Shri M. H. Dhulkhed, Scientist S-3 attended the meeting on antipollution measures for caustic soda factory, Binage. Karwar, 24 May.

Shri M. Kumaran, Scientist S-3 and **Dr. R. S. Lal Mohan**, Scientist S-2 participated in the Workshop of the State Committee on Science, Technology and Environment for the development of Kozhikode, 18-19 June.

Dr. S. Ramamurthy, Scientist S-3 attended the following:

NABARD conference on Fisheries Development through Institutional Finance. Madras, 29-30 April.

Meeting of the Ministry of Food and Agriculture on the assessment of fluctuations in penaeid prawn landings. Madras, 6 June.

Meeting of the Madras Base Advisory Committee of FSI. Madras, 18 August and 3 March.

Dr. M.M. Thomas, Officer-in-Charge KVK/TTC attended the workshops of the Kerala Agricultural Extension Programmes. He attended the Farmers Meet organised by MPEDA and State Bank of Travancore at Ernakulam on 25 Sept. Dr. Thomas also atended the meeting of the Chief Training Organisers and the programme on Management of Development Services for Women and Children through Agriculture and Farm Activities, both at New Delhi in February.

Shri M. S. Muthu, Scientist S-3 and **Shri K. Asokakumaran Unnithan**, Senior Training Assistant attended the seminar on Brackishwater Prawn Farming organised by MPEDA and Indian Bank, Cannanore, 23 October.

Shri P. Karunakaran Nair, Senior Training Assistant attended the Workshop of Kerala Agricultural Extension Programme. Perumbavoor, 28-29 October.

Shri R. Marichamy, Scientist S-2 participated in the All India Symposium on Estuarine Biology, Portonovo, 26-28 October.

Shri M. H. Dhulkhed, Scientist S-3 attended the meeting of the Mormugoa Zone of FSI on 28 November. Shri Dhulkhed, Shri K. Y. Telang and Dr. V. S. Kakati participated in the Seminar on Prawn Farming and Integrated Rural Development. Karwar, 9-10 December.

Mrs. Jancy Jacob, Scientist S-1 participated in the National Seminar on Extension Education in Human Resource Development. Hyderabad, 14-17 November.

Dr. (Mrs.) V. Chandrika, Scientist S-2 participated in the FAO/INFOFISH Technical Consultation on Fish Inspection and Quality Assurance for Asia and Pacific. Cochin, 16-19 February.

Dr. K. Satyanarayana Rao served as member of the MPEDA Committee to study the exploitation of cephalopods in the Visakhapatnam, Veraval and Kerala coasts.

Dr. D. B. James, Scientist S-2 served as the CMFRI member on the reconstituted Committee on *Beche-de-mer*.

Dr. K. A. Narasimham, Scientist S-3 served as member of the ICAR team to tour flood affected areas of Andhra Pradesh and report on technical inputs required by fish farms.

Visitors

Cochin

Shri Nilamani Das, Minister for Agriculture, Govt. of Assam and Shri Hrishbhaben Bharati, MLA, 21 September.

Dr. N. A. Jan, Director of Fisheries, Govt. of Jammu & Kashmir, 29 September.

Shri Manivannan, IAS, Director of Fisheries, Tamil Nadu.

Dr. Wayana V. Burt, Prof. Emeritus, Oregon State University, USA, 16 February.

Prof. S. L. Shanbogue, Fisheries College, Mangalore, 20 February.

Veraval

Prof. N. D. Chhaya, Deputy Commissioner of Fisheries, Govt. of Gujarat.

The Second-Sub-Committee of the Committee of Parliament on Official Languages, 17 January.

Bombay

Prof. Saad K. El. Wakeel and 7 students, University of Qatar, 11 March.

Karwar

Shri Rathinath Roy, Director, Catalyst Group Development Environmental Planners, Madras.

Mangalore

Mr. Urbe Yorla Woli, FAO Fellow, University of Juba, Sudan.

Calicut

Shri A. S. Rose, Chairman, National Shipping Board.

Minicoy

Shri V. M. Sudheeran, Speaker, Kerala Legislative Assembly, 19 December.

Tuticorin

Mr. Lexan, Institue of Marine Products, Vietnam.

Shri M. Sakthivel, MPEDA, Cochin.

Shri A. Sathyanarayana, Member, Income-tax Appellate Tribunal, Cochin.

Wg Cdr G. S. Madan, Air Headquarters, New Delhi.

Shri N. K. Vasudevan, Principal, Fisheries Staff Training Institute, Madras with trainees.

Shri Vibhakar Sharma, IPS, Superintendent of Police, Tirunelveli.

Shri G. Venkatesan, Deputy Director, MPEDA.

Capt. A. Almeida, M/s. Pereira Roche and Co., Tuticorin.

Shri Subadra Menon, Department of Biology, University of Delhi.

Shri Ramachandran, Chief Engineer (Operation), T&C, Tuticorin.

Dr. Charles L. Angell, BOBP Madras.

Shri K. K. Kaul, Deputy Commandant, CISF, Tuticorin Port Trust.

Shri K. V. Balakrishnan, General Manager, Southern Railway, Madras.

Dr. B. T. Antony Raja, Consultant, BOBP, Madras.

Shri N. K. Vasudevan, Principal, Fisheries Staff Training Institute, Madras with trainees.

Shri D. R. Joel, Fisheries College, Tuticorin with students.

Shri C. D. Sethi, Department of Zoology, Holy Cross College, Trichy with students.

Dr. Fred P. Meyer, National Fisheries Research Centre, Winconsin, USA.

Dr. Val Mozainis, USDA/OTCD, Washington.

Dr. Harry Dupres, Fish Farming Experimental Station, USA.

Dr. Les Torrans, Agricultural Experiments Station, University of Ark, USA.

Mandapam Camp

Shri N. Shanmugham, Education Officer, Kendriya Vidyalaya Sangathan, Madras.

Dr. V. Rajeshwaran, MP, Ramanathapuram.

Shri R. Rajamani, Additional Secretary, Cabinet Secretariat, New Delhi

Dr. Charles L. Angell, FAO, BOBP, Madras.

Dr. Geoffrey R. Ames, Principal Scientific Officer, Tropical Development and Research Institute, London.

Dr. P. Reyntynes, FAO, BOBP, Madras.

Shri K. G. Sawrikar, Member, Maharashtra Council for Agricultural Research and Education.

Prof. Shirely L. Arora, Professor of Biology, California, State University. USA.

Dr. Joseph Nejdedly, Managing Director, Prega Industries, Coimbatore, 26 March.

Madras

Prof. Frank J. Schwartz, Institute of Marine Sciences, University of North Carolina.

Dr. Varaprasada Rao, IAS, Sub-Collector, Chinglepet.

Shri K. Sivaramakrishnan, Special Secretary (Fisheries), Government of Maharashtra, 30 January.

Mr. Jacques Trichereau, Research Associate, French Polynesia, 6-7 February.

Kakinada

CIFE Postgraduate trainees accompanied by S/Shri A. K. Sharma, S.S.H. Rizini, C. Venugopalan and Dr. W. S. Larka.

Shri B. Ramajoguswara Rao, Analapuram College, with students, 6 January.

The students on study tour from the following Institutions visited Cochin/other centres.

Farook College, Calicut; NSS College, Trivandrum; BCM College, Kottayam; Inland Fisheries Technology Centre, Barrackpore; CIFE, Bombay; Catholicate College, Pathanamthitta; Department of Zoology, Kerala University; St. Xavier's College, Trichy; Dept. of Zoology, Madras University; Muslim Educational Society, Madras; Sivaji University, Kolhapur; Andhra University; College of Fisheries, Ratnagiri.

Seminars

A Seminar on Potential Marine Fisheries Resources was organised by the Institute at Cochin on 23 April to mark the occasion of the Institute moving into its own building. The Seminar was inaugurated by Dr. K. Gopalan, Vice-Chancellor, Cochin University. The seminar consisted of 4 technical sessions and was attended by about 300 delegates.

A National Seminar on Shellfish Resources and Farming was conducted by the Institute at the Tuticorin Research Centre from 19-21 January. The Seminar inaugurated by Shri A. Arumugham, District Collector, Chidambanar District drew attention to the growing importance of shellfish. Dr. R. M. Acharya, D.D.G. (Animal Sciences), ICAR presided over the inaugural session. Dr. P. V. Dehadrai, D.D. G. (Fisheries), ICAR released two bulletins, one on Oyster Culture Status and Prospects (No. 38) and the other on Pearl Culture (No. 39). The bulletins were brought out by the Institute to mark the occasion. About 100 papers were presented and around 160 delegates participated.

Scientists deputed abroad for Training/Assignment/ Workshop etc.

1.	Dr. K. Alagarswami Scientist S-3	... Deputed to UK to undergo Post-Experience Fisheries Planning and Management course for ... 3 months at Humberside College, UK from 7th April, under the Colombo Plan.
2.	Syed Ahamed Ali Scientist S-2	... Deputed to The Netherlands to undergo training in Biochemistry of Steriods at the Zoological Laboratory of the University of Utrecht, Netherlands for 6 months from 7th April, under the FAO/UNDP programme.
3.	Dr. E. G. Silas Scientist S-5	... Deputed to attend a Workshop on Conservation of Mangrove Areas for Aquaculture, at Iloilo, Philippines from 22-29 April, under the FAO.
4.	Dr. E. G. Silas Scientist S-5	... Deputed to participate in the discussion on Management of Fisheries and Aquaculture in Mangrove Eco-systems, Indonesia, June 1986.
5.	Shri K. Devarajan Scientist S-2	... Deputed to Philippines to undergo a short-term training course on Small-scale Shrimp Hatchery/Nursery Operations and Management, organised by the Network of Aquaculture Centre of Asia, at Iloilo from 4-8-86 to 30-9-86.
6.	Dr. P. Bensam Scientist S-2	... Deputed to attend a training course on Net Cage Culture of Marine Finfish in Coastal Water from 1-9-86 to 11-10-86 at Singapore.
7.	Dr. P. Nammalwar Scientist S-2	
8.	Dr. P. S. B. R. James Director	... Deputed to participate in the ACIAR Workshop on "Culture and Management of Sea Bass" at Darwin, Australia from 24-9-86 to 1-10-86.
9.	Dr. H. Mohamed Kasim Scientist S-2	
10.	Dr. R. S. Lal Mohan Scientist S-2	... Deputed to China for attending a Workshop on Biology and Conservation of Platanistoid Dolphins at Wuhan, October 1986.
11.	Dr. P. S. B. R. James Director	... Participated in the Expert Consultation on the Stock Assessment of Tunas in the Indian Ocean, Colombo, 4-8 December.
12.	Dr. P. P. Pillai Scientist S-3	
13.	Dr. A. D. Diwan Scientist S-2	... Deputed for training in Bio-assay Procedures and Experimental Design on Toxicity Studies at the University of Washington, for six months from 27 December, under the FAO/UNDP.

COMMITTEES

Management Committee

1.	Dr. P. S. B. R. James, Director, CMFRI	...	Chairman
2.	Dr. M. Y. Kamal, Assistant Director-General (F), ICAR, New Delhi.	...	Member
3.	Shri C. T. Sukumaran, Director, Department of Fisheries and Ports, Government of Kerala, Trivandrum.	...	Member
4.	Shri S. K. Pattanayak, Director of Fisheries, Karnataka	...	Member
5.	Dr. M. J. Sebastian, Dean, Fisheries College, Panangad.	...	Member
6.	Shri K. Balaram, General Secretary, INTUC (A.P) Visakhapatnam	...	Member
7.	Shri K. Viswanathan, Director, Mitra Niketan, Vellanad, Kerala	...	Member
8.	Shri S. P. Nair, Asst. Accounts Officer, CIFT, Cochin	...	Member
9.	Shri K. Venkatanarayana Rao, Scientist S-3 CMFRI	...	Member
10.	Shri T. Jacob, Scientist S-3, CMFRI	...	Member
11.	Shri C. P. Ramamirtham, Scientist S-2, CMFRI	...	Member
12.	Dr. P. Bensam, Scientist S-2, CMFRI	...	Member
13.	Shri P. C. Jacob, Administrative Officer, CMFRI	...	Member Secretary

Joint Council

1.	Dr. P. S. B. R. James, Director	...	Chairman
2.	Dr. P. Vedavyasa Rao, Scientist S-3	...	Member
3.	Dr. K. Radhakrishna, Scientist S-3	...	Member
4.	Dr. K. C. George, Scientist S-3	...	Member
5.	Shri P. C. Jacob, Administrative Officer	...	Secretary (official side)
6.	Shri M. Abdul Nizar, JTA (T-2)	...	Member
7.	Shri K. Soman, T. A. (T.II.3)	...	Member
8.	Shri H. Kather Batcha, T.A. (T.I.3)	...	Member

9. Shri Joseph Andrews, T.A. (T.I.3)	...	Member
10. Shri A. P. Sebastian, S.S. Grade II (Peon)	...	Member
11. Shri K. Ganesan, S.S. Grade II (Watchman)	...	Member
12. Shri K. Muthuramalingam, S.S. Grade IV (L.A.)	...	Member
13. Shri A. K. Balakrishna Pillai, Superintendent	...	Secretary (staff side)
14. Shri B. Vijayakumar, Senior Clerk	...	Member

Grievance Cell

1. Dr. K. Alagaraja, Scientist S-3	...	Chairman
2. Shri P. C. Jacob, Administrative Officer	...	Member
3. Shri T. Gopinathan, Assistant Accounts Officer	...	Member
4. Shri B. Vijayakumar, Senior Clerk	...	Member
5. Shri K. Muthuramalingam, S. S. Grade IV (L.A.)	...	Member
6. Shri S. R. Narayanan, Superintendent	...	Non-Member Secretary

PROGRESS OF RESEARCH

FISHERY RESOURCES ASSESSMENT DIVISION

The marine fish landings in India during 1986 have been provisionally estimated as 1.72 million t along with contributions of commercially important groups to facilitate stock assessment. A procedure called maximum contribution approach has been evolved to arrive at estimates of the potential harvestable yields. A method of estimating mortality using length frequency data was developed. Stock assessment of tunas was carried out at selected centres. Comprehensive reports on the marine fisheries in different maritime states were prepared. Zonal workshops were held for the field staff of the Institute collecting the marine fish landing data. A ten day training programme on the sampling design for collection of marine fish catch statistics was conducted for the benefit of the officials of the state fisheries departments. A six week intensive training programme on fishery resources assessment including population dynamics was conducted. The participants included the scientists and officials of Agricultural universities, State Fisheries Department and the CMFRI. Scientists of this Division served as faculty members in the postgraduate programme of research in mariculture. Scientists and Technical staff of the Division participated in the cruise programmes of FORV Sagar Sampada.

Acquisition of data on exploited marine fishery resources for stock assessment (FSS/FRA/1.1)

The marine fish landings in India during 1986 were provisionally estimated as 1.72 million t registering an increase of about 12.2% over that of 1985. The mechanised landings accounted for about 75% of the total landings.

The salient feature of the landings during this year was the bumper catch of carangids (144,700 t) recording an increase of about 90,000 t over that of the previous year. Another significant feature was the high landings of mackerel (81,900 t). This resulted in an increase of about 20,100 t from that of the previous year. Among the other commercially important varieties, *Stolephorus* spp showed an increase of about 36,860 t followed by perches (+21,400 t), silverbellies (+18,300 t), penaeid prawns (+17,300 t) and ribbonfish (+11,000 t). A decline of about 41,800 t and 18,000 t were recorded in the landings of oilsardine and Bombay-duck respectively. However, this decline was more than compensated by higher landings of the other commercially important varieties which resulted in the overall improvement in the country's landings.

Pelagic and demersal groups

The landings of the pelagic fishes were provisionally estimated as 887,500 t forming about 52% of the total landings and the rest about 835,800 t by the demersal group. The estimated landings are given in Tables I (a) and I (b).

(a) Pelagic group

Among the pelagic fishes, the carangids ranked first with record landings of about 144,700 t forming 16.3% of the pelagic landings followed by ribbon fish (10.7%), Bombayduck (10.6%), *Stolephorus* spp. (10.1%), mackerel (9.1%) and oilsardine (8.9%).

Oil sardine

The landings during the year registered a fall of about 34.7% from the previous year's landings of about 120,600 t. This was mainly due to a reduction of about 39.7% in the south west region. However, the south east region registered an increase of about 4600 t.

Bombayduck

A decline of about 18,000 t (15.9%) was observed from that of the previous year and was due to the fall in landings in the north west region. This region accounted for about 98% of the total landings in India.

***Stolephorus* spp.**

A notable increase of about 36,800 t (69.2%) was noticed from that of the previous year. The south west region accounted for about 70% of the landings in the country followed by the south east region (27.9%), the respective gains in these regions being about 22,600 t and 14,300 t.

Carangids

The landings touched an all time high of 144,700 t and ranked first in the marine fish landings during the year. This was mainly brought about by an increase of about 87,400 t in the south west region from the previous year's landings, the region accounting for about 78% of the total carangid landings in the country.

Ribbonfish

The estimated landings of this group during the year were 95,500 t showing an increase of 13% over that of the previous year and was mainly due to higher landings in the north west region (45,000 t) followed by the south east region (26,000 t). However, there was a decline of about 7200 t from that of previous year in the south west region.

Mackerel

A remarkable feature of this year was the record high landings in the south east region. The landings increased from about 11,000 in 1985 to about 35,600 t in 1986. The south west region, however, recorded a decline of about 5300 t from the previous year's landings of about 48,800 t. These two regions accounted for about 96.6% of the total landings in the country.

(b) Demersal group

In the demersal group, among the commercially important varieties, penaeid prawns ranked first accounting for 16.7% of the demersal landings followed by croakers (12.6%), perches (11.2%), non-penaeid prawns (8.7%), silverbellies (8.5%), catfish (6.3%), elasmobranchs (6.2%) and pomfrets (3.5%).

Penaeid prawns

The estimated landings of about 139,200 t during this year were 14.2% more than that of the previous year. The north west region with estimated landings of about 61,200 t ranked first followed by the south west region (46,800 t), the south east (27,800 t) and the north east (3,300 t). While the north west region registered a fall of about 3300 t, the other regions registered an increase from that of the previous year, the most notable were the south west region (+12,100 t) and the south east region (+8,100 t).

Non penaeid prawns

The landings increased by 8.9% from about 67,100 t in 1985 to 73,000 t this year. The north west region accounted for about 94% of the total of non-penaeid prawn landings in the country. The landings in this region registered an increase of about 6000 t from that of the previous year. The south east region which accounted for about 4% of the non-penaeid prawn landings in India, registered an increase of about 1400 t from the previous year's landings.

Croakers

There was an increase of about 3.9% from the previous year's landings. This year the landings were 105,200 t. The north west region with an estimated landing of about 55,100 t accounted for 52.3% of the total croaker landings in the country followed by the south west region (18%), the south east region (15.7%) and the remaining by the north east region. While the north west region and the north east region registered a decline of about 2500 and 1500 t respectively, the south west region and the south east region showed a gain, of about 6500 and 1600 t respectively from that of the previous year.

Perches

A notable increase of about 21,400t was observed in the landings from that of the previous year. The landings during the year were about 93,500 t. The south west region accounted for 56% of the total perches landed in the country. The other major contributors were the south east region (22.1%) and the north west region (13.3%). The south west region registered an increase of about 18,300 t from that of the previous year, whereas a decline of about 700 and 1800 t was noticed in the south east and the north west regions respectively. Threadfinbreams formed 64% of the total perches landed and its share in the south west region was 80%.

Silverbellies

An increase of about 18,300 t was observed in the landings of this group from that of the previous year, the

landings during the year being 71,000 t. The south east and south west regions together accounted for 98.6% of the landings, the former's share being 71.8%. There were increases of about 12,300 t in the south west region and about 7000 t in the south east region.

Catfish

The landings were estimated as 52,400 t showing an increase of about 17.7% over that of the previous year. The north west region ranked first with estimated landings of about 22,700 t forming about 43.3% of the catfish landed in India. The other regions in the order of magnitude of landings were south west region (17,200 t), south east region (6,300 t) and north east region (6,000 t). While the north west and the south west regions showed an increase of about 900 and 10,000 t respectively, the south east and the north east regions suffered a decline of about 1000 and 900 t respectively.

Elasmobranchs

A marginal decline of about 700 t was noticed from the previous year's landings of about 52,900 t. The north west and the south west regions together accounted for about 74.1% of the elasmobranchs landed in the country, with the former accounting for 39.4%. The south east region and the north east region accounted for 17.1 and 8.8 percent respectively. While the north west region suffered a decline of 4300 t the other regions recorded increase in the landings from that of the previous year, the gain being 900 t, each in south west and south east and 1500 t in the north east region.

Pomfrets

A fall of about 3,200 t was noticed in the landings from that of the previous year's landings of about 29,400 t. About 98.9% of the landings were accounted for by the silver pomfrets and the black pomfrets, the former's share being 64.6%. While there was only a marginal decrease of 100 t in black pomfrets, a sharp fall of about 3,700 t was noticed in the silver pomfret landings. The north west region accounted for 60.7% of the total pomfret landings in the country. The other regions which had major contributions were the north east region (17.4%) and the south west region (12.1%).

Region-wise estimates

North East region

This region comprising, West Bengal and Orissa accounted for 4.1% of the all India landings. The total landings were estimated at 70,500 t which was of about the same magnitude as in 1985. Croakers (14,600 t), catfish (6,000 t), pomfrets (5,200 t), elasmobranchs (3,900 t), other sardines (3,700 t) and penaeid prawns (3,300 t) were the commercially important varieties which accounted for 52% of the total landings of the region.

South East region

In this region comprising of Andhra Pradesh, Tamil Nadu and Pondicherry, the landings during 1986 were estimated as 408,500 t which formed 23.7% of the country's landings, and registered an increase of about 21.6%

over that of the previous year. Bumper landings of about 35,000 t of mackerel was the salient feature of the landings during this year which formed about 11.8% of the total landings of the region. Oil sardine also recorded a good landing (9,100 t) and accounted for 2.2% of the total landings. The other commercially important varieties were silverbellies (12.5%), other sardines (11.8%), penaeid prawns (6.8%), ribbonfish (6.4%), *Stolephorus* spp (6.1%), perches (5.1%) and elasmobranchs (4.4%).

South West region

This region comprising of Kerala, Karnataka and Goa with an estimated landings of 661,600 t ranked first in the marine fish landings in the country and accounted for 38.3% of the total landings, showing an increase of about 34% from that of the previous year. A notable feature was the unprecedented landings of carangids (113,900 t). Oil sardine landings showed a decline of about 41,600 t from that of the previous year. There was a significant improvement in the landings of *Stolephorus* spp. The percentage contribution of carangids, oil sardine, *Stolephorus* spp., perches, penaeid prawns and mackerel were 17.2, 11.0, 9.6, 8.1, 6.9 and 6.5 respectively.

North West region

This region comprising Maharashtra and Gujarat accounted for about one third of the all India landings, the estimated landings in the region during the year being 574,200 t which was about 8% less than that in 1985. The major contributors to the landings were Bombay duck, non penaeid prawns, penaeid prawns, croakers and pomfrets, accounting for 16.1, 11.9, 10.7, 9.6 and 4.2 per cent respectively of the total landings.

Andaman and Nicobar Islands

The estimates for 1986 and 1985 were not available, hence the estimated landings at these islands during 1984 were included to arrive at the all India landings for 1986. The total landings for 1984 were estimated as 6,226 t. About 61.8% of the landings was accounted together by other sardines (18.0%), perches (13.9%), mackerel (9.1%), carangids (8.1%), silverbellies (6.1%), tuna (3.4%) and penaeid prawns (3.2%).

Lakshadweep

Since the estimated landings for 1986 were not available, the landings during 1985 were included to arrive at the all India landings for 1986. During 1985, the total landings were estimated as 4,629 t. About 81.6% of the landings was accounted for by tunas. Among the other commercially important varieties, elasmobranchs accounted for 4.9% followed by perches (2.5%), bill fish (1.6%) and seer fish (1.2%).

National Marine Living Resources Data Centre (FSS/FRA/ST.1)

Action was taken for providing infrastructure facilities for establishing

a computer centre. Standard proformae with coded formats were prepared for recording fishery survey data. Information on catch and effort of major resources were disseminated to the end users.

Stock assessment of commercially important fishes of exploited zone (FSS/FRA/1.3)

Stock assessment of tunas was carried out at selected centres. Data on catch, effort and other biological aspects during the period 1982-'83 to 1985-'86 on the commercially important species of tuna at Mangalore, Cochin, Calicut, Vizhinjam and Tuticorin along the coast and the Lakshadweep Islands were analysed. The effect of fishing on the stocks of *Euthynnus affinis*, *Auxis thazard* and *Katsuwonus pelamis* was indicated and the estimates of standing and average annual stocks arrived at. It was found that in the case of *E affinis* except at Mangalore and Vizhinjam, at all other centres there is likely to be an increase in yield with increase in fishing effort. In the case of *A. thazard* it was found that there may not be a significant increase in yield at Cochin with increase in effort. However, it was found that at Tuticorin, increased effort may result in increased catches. At Minicoy, there is scope for getting increased catches of *K. pelamis* with increase in effort.

A simple technique "maximum contribution approach" was evolved to estimate the potential harvestable yield. A method was developed for estimating mortality rate from the length frequency data. Comprehensive reports were prepared on the marine fisheries in the different maritime states of India. These reports highlight the trend of marine fisheries over the decade from 1975 to 1984 and also provide estimates of potential harvestable yields along with the harvesting strategies for rational exploitation of the fish stocks.

Table — I a : Estimated pelagic landings in India during 1986 and 1985

(Figs. in tonnes)

	Name of fish	*1986	1985
1.	CLUPEIDS		
	a) Wolf herring	14657	17713
	b) Oil sardine	78740	120587
	c) Other sardines	69401	60773
	d) Hilsa shad	4129	9154
	e) Other shads	15717	11827
	f) Anchovies		
	Coilia sp	27402	25996
	Setipinna sp	3875	2870
	Stolephorus sp	89952	53191
	Thrissina sp	...	...
	Thrissa sp	27012	28187
	g) Other clupeids	36874	34274
2.	BOMBAY DUCK	94545	112454
3.	HALF BEAKS & FULL BEAKS	1874	2112
4.	FLYING FISHES	1595	1241
5.	RIBBON FISHES	95528	84403
6.	CARANGIDS		
	a) Horse Mackerel	9770	3486
	b) Scads	57635	7901
	c) Leather-jackets	3506	8666
	d) Other carangids	73749	34651
7.	MACKERELS		
	a) Indian mackerel	81890	61775
	b) Other mackerels	85	85
8.	SEER FISHES		
	a) *S. commersoni*	20331	16603
	b) *S. guttatus*	12257	17435
	c) *S. lineolatus*	402	40
	d) *Acanthocybium* sp	36	...
9.	TUNNIES		
	a) *E. affinis*	18116	16625
	b) *Auxis spp.*	8485	3076
	c) *K. pelamis*	3195	3201
	d) *T. tonggol*	185	1087
	e) Other tunnies	2596	7272
10.	BILL FISHES	1486	1102
11.	BARRACUDAS	4355	3372
12.	MULLETS	3440	5336
13.	UNICORN COD	587	734
14.	MISCELLANEOUS	24128	26779
	TOTAL	887535	784008

* Provisional

Table — Ib : Estimated demersal landings in India during 1986 and 1985

(Figs. in tonnes)

	Name of fish	*1986	1985
1.	ELASMOBRANCHS		
	a) Sharks	33151	33571
	b) Skates	3401	3523
	c) Rays	15634	15710
2.	EELS	7874	8302
3.	CAT FISHES	52376	44500
4.	LIZARD FISHES	14721	13332
5.	PERCHES		
	a) Rock cods	2609	3264
	b) Snappers	2668	4098
	c) Pig-face breams	2683	2311
	d) Threadfin breams	60177	38745
	e) Other perches	25171	23395
6.	GOATFISHES	7250	5375
7.	THREADFINS	6889	9059
8.	CROAKERS	105188	101078
9.	SILVER BELLIES	70988	52725
10.	BIG-JAWED JUMPER	15803	25337
11.	POMFRETS		
	a) Black pomfret	10445	10177
	b) Silver pomfret	18986	22698
	c) Chinese pomfret	315	99
12.	FLATFISHES		
	a) Halibut	1276	1828
	b) Flounders	150	115
	c) Soles	28167	27669
13.	CRUSTACEANS		
	a) Penaeid prawns	139235	121958
	b) Non-penaeid prawns	72977	67084
	c) Lobsters	3154	4083
	d) Crabs	20788	22271
	e) Stomatopods	48110	31183
14.	CEPHALOPODS	42911	31586
15.	MISCELLANEOUS	22723	25642
	TOTAL	835820	750718

* Provisional

Personnel associated with the projects of the Division

T. Jacob, K. Alagaraja, S. K. Dharmaraja, K. Narayana Kurup, K. Balan, M. Srinath, K.S. Scariah, K. Vijayalakshmi, S. Karthikeyan, S. S. Dan, J. P. Karbhari, G. Balakrishnan, U. K. Satyavan, Varughese Philipose, K. C. Yohannan, P. K. Mahadevan Pillai, Varughese Jacob, G. Krishnankutty Nair, P. Sivaraman, V. Rajendran, V. P. Annam, P. Karunakaran Nair, Abha Kant, Joseph Andrews, A. Kanakkan, S. Haja Najimudeen, C. J. Prasad, P. L. Ammini, K. P. George, M. B. Seynudeen, P. P. Pavithran, M. Ramachandran, K. Anandan, G. Subbaraman, P. T. Mani, M. R. Beena, Lata Thote, Pulin Behari Dey, Sapan Kumar Ghosh, Sukdev Bar, K. R. Somayajulu, K. Dhanaraju, V. Achutha Rao, M. Radhakrishnan, S. Satya Rao, M. Chandrasekhar, C. V. Seshagiri Rao, K. Chitti Babu, K. V. S. Seshagiri Rao P. Ananda Rao, T. Chandrasekhara Rao, A. Hanumantha Rao, G. C. Lakshmaiah, A. Agastheesa Pillai Mudaliar, M. Mohamed Sultan, H. Kather Batcha, M. Bose, S. Manivasagam, L. Chidambaram, A. Srinivasan, M. Manivasagam, L. Jeyasankaran, R. Somu, V. Thanapathi, V. Sivaswamy, A. Ganapathy, P. Palani, K. Muthaiah, Hameed Batcha, A. Kumar, K. Muniyandi, K. S. Krishnan, S. Sankaralingam, R. Subramaniam, C. Kasinathan, S. Subramani, O. M. M. J. Habeeb Mohamed, R. Gurusamy, K. Ramakrishnan Nair, N. Retnaswamy, I. P. Ebenezer, Jacob Jerald Joel, R. Bhaskaran Achari, M. Babu Philip, T. G. Vijaya Warrier, S. B. Chandrangathan, V. S. Gopal, A. A. Thankappan, K. Thulasidas, N. Palaniswami, M. B. Renu Kumar, C. K. Krishnan, T. Girijavallabhan, K. Soman, T. Krishnankutty, K. C. Purushothaman, B. Sreedhara, H. S. Mahadevaswamy, K. Chandran, Maruthi Sankar Naik, Ahamed Kamal Basha, T. B. Harikantra, Devidas Y. Nayak, U. V. Argeker, S. N. V. Pai, T. S. Balasubramaniam, R. B. Kamble, A. Prosper, K. Ramdoss Gandhi, D. G. Jadhav, M. Shriram, J. L. Oza, K. B. Waghmare, C. J. Josekutty, Johny R. Dias, B. N. Katkar, S. D. Kamble, M. Chellappa, Y. D. Savaria, B. V. Makadia, S. S. Sugawekar, Zala Mangal Singh, V. J. Dayabhai.

PELAGIC FISHERIES DIVISION

The major activities in the division were focussed on capture fisheries carried out under 16 projects. The investigations during 1986-87 were concerned with monitoring and evaluation of resource characteristics and stock assessment of tunas, bill fishes, oil sardines, lesser sardines, anchovies, mackerel, Bombay duck, pomfrets, seer fishes, carangids, and other major exploited pelagic fisheries. The Scientists of this division were also involved in the inter-divisional projects and also the Post-Graduate Education and Research Programme in Mariculture. Good progress has been achieved in the work on unit stocks of pelagic species. Achievements under each project are presented.

Investigations on the resources of tunas and related fishes (FB/PR/3.1)

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The work was carried out at selected centres like Goa, Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Madras and Vizag., in the mainland; Minicoy and Agatti in Lakshadweep.

At Minicoy the estimated catch was 574.6 t at a C/SE of 217.4 kg constituting 98.8% of the total catch. The highest monthly catch of 153.6 t at a C/SE of 397.9 kg was recorded in April followed by 77.8 t at C/SE of 268.8 kg. in December. Pole and line contributed 98% and troll-line the rest. In the pole and line, skipjack tuna *(Katsuwonus pelamis)* constituted 91.6% followed by yellowfin tuna *Thunnus albacares* 8.2% and the little tunny the rest. In the troll-line catch skipjack formed 55% and yellowfin tuna 38% and the bill fish *Istiophorus platyterus* 6.3%. Fish in the size groups 33-71 cm and 48-62 cm contributed to the skipjack fishery. Maturing, mature and partly spent fish were observed. The spawning period appeared to be spread throughout the year and the fish spawned several times during the year. A surface temperature of 28-31°C and salinity of 34‰ were found to be optimum for tuna schools around Minicoy.

At Agatti 50 pole and line were operated on an average of 20 days in a month during the season. At Suhelipar and Bitra, units operated were 20 and 15 respectively. The C/E in all these centres worked out to be 250 kg.

At Goa the estimated catch was 65 t at a C/E of 10.3 kg which showed an increase of 115.6% compared to that of last year. Drift gill net was employed. The species which supported the fishery were *T. tonggol* (47.6%), *Euthynnus affinis* (37.5%) and *Auxis thazard* (14.9%). The size ranged from

28-97 cm for *T. tonggol* and 22-41 cm for *A. thazard.*

At Mangalore purse seines and drift gill nets landed a catch of 1679 t as against 2220 t last year. The third quarter appeared to be the best season accounting for 99.8% of the total tunas landed. About 91% was from purse seines and the rest by drift gill nets. The effort expended by the purse seines decreased from the 13197 units of last year to 9963 units. In the drift gillnets fishery, the effort expended increased from the 2707 units of last year to 4101 this year and registered a three fold increase in the C/E. The purse seine catch was composed of *E. affinis* (73%), *A. thazard* (25%) and *A. rochei* (4%). In the drift gill net catch a variety of small tunas were observed and *T. tonggol* (79%) was the dominant species, followed by *E. affinis* (15%).

The estimated catch at Malpe was 323 t The purse seine catch amounted to 265 t (82%) at a C/E of 29.7 kg and the rest was shared by drift gill nets. *A. thazard* (39%) followed by *A. rochei* (34%) dominated the drift net catch. The little tunny and frigate mackerel ranging from 18-48 cm and 18-44 cm. respectively were recorded in the purse seine catches whereas in the drift gill net catch the little tunny and the frigate mackerel measured from 36-60 cm and 28-48 cm respectively. Long tail tuna and bullet tuna caught in the drift gill net ranged from 32-82 and 19-36 cm respectively.

The fishery at Vellayil (Calicut) improved yielding 314.8 t as against 93 t last year. The best catch (58.6%) was observed during October at a C/E of 115 kg. The increase in effort along with the mechanisation of the country craft were mainly responsible for the increased catch. The catch was composed of *E. affinis* (90.9%), frigate tuna (4.4%) and longtail tuna (4.8%). The size range of little tunny was 20-70 cm and the fishery was supported by the 35-40 cm group.

The catch at Fisheries Harbour, Cochin by the purse seines and drift gill nets amounted to 1864 t. as against 820 t last year (127% increase). The purse seines contributed to 72% and drift gill nets 28% of the catch. Compared to last year the purse seine catch increased by 4 times, whereas a 4% decrease was recorded in the drift gill net catch. The catch/standard effort varied from 1.34-88.77 kg. The purse seine catch was only during April and September. In the drift gill nets, tunas occurred throughout the year with a peak during April-June. The purse seine catch was composed of three species such as little tunny, frigate tuna and bullet tuna. The little tunny was the dominant species in both the gears followed by frigate tuna. The longtail tuna formed only 3.6% of the catch. The size of little tunny ranged from 24-72 cm with the 38-54 cm group supporting the fishery and that of frigate tuna 18-48 cm with the 30-38 cm group supporting the fishery. The size ranges of longtail and bullet tunas were 34-58 cm and 16-38 cm respectively.

The estimated catch was 1758 t at Vizhinjam. The hooks and lines by mechanised units contributed 58%, non-mechanised units 12%, mechanised drift gill nets 24% and non-mechanised units 6%. In general the catch declined by 20% when compared to that of last year. In the drift gill net catches little tunny dominated forming 59.63% whereas bullet tunas dominated in the hook and line catches forming 67-83%. Bullet tunas (59%) and little tunny (28%) formed the bulk of the tuna landings. Frigate tuna and oriental bonito formed 8% and 3% respectively. Negligible quantities of long tail tuna, yellow fin tuna and skipjack were also recorded in the catch.

A catch of 954 t at a C/E of 121 kg was recorded at Tuticorin with an increase of 16% when compared to that of last year. The peak season was July-August when the catch amounted to 98.8%. The little tunny formed 59.9% of the catch, frigate tuna 20.5%, oriental bonito 4.7%, yellowfin 3.1% while other tunas and billifishes formed the rest. The sizes ranged from 18-74 cm and 18-46 cm for *E. affinis* and *A. thazard* respectively.

At Madras the catch from 3208 gill net units operated amounted to 40.5 t at a C/E of 12.6 kg. Moderately good catches were observed during June, July and February. *E. affinis* (69.2%) dominated the fishery, followed by yellowfin tuna (15.4%) and frigate tuna (14.3%).

The estimated catch at Waltair was 45.5 t. The little tunny formed 75.6% of the catch followed by yellowfin tuna, 23.5%. The bill fishes constituted 8.7 t. The peak season appeared to be May-June.

Resources and biological studies of tuna live-baits in the U.T. of Lakshadweep (FB/PR/3.2)

P. P. Pillai, G. Gopakumar

At Minicoy about 7 t of tuna live-baits were caught from the lagoon and reef areas. Bulk of the live-bait were taken during April (15.4%), October (13.0%) and March (19.4%). The total catch during the period was higher than that of the previous year.

The baitfishes caught comprised of sprats, pomacentrids, apogonids and caesionids. Sprats were the most abundant group constituting 32.3% of the total catch. *Spratelloides delicatulus* formed 29.7% and *S. gracilis* 2.6% of the total catch of sprats. Eventhough *S. delicatulus* was available in almost all months, it was abundant during the September-October period. Apogonids represented by *Archamia fucata, Apogon sangiensis* and *Rhabdamia gracilis* contributed 29.6% of the total bait catch and were obtained during December-March. Caesionids constituted 26.9% of the total catch and were represented mainly by *Caesio caerulareus, Gymnocaesio gymnopterus, Caesio xanthonotus, Pterocaesio pisang* and *P. tile.* They were abundant during April-May. Pomacentrids were represented by *Chromis caeruleus* and *Lepidozygus tapaeinosoma* which formed 5.8% and 5.3% respectively of the

total catch. *C. caeruleus* was abundant in November and *L. tapaeinosoma* in April. *C. caeruleus* stocked in the rearing cage was found to remain in capitivity for about two months. Further experiments were continued.

Tuna catch was directly related to the availability and abundance of live-bait. The period of good availability of tunas viz., April, May, September, October, December and January were the months of good availability of tuna live-baits. Catch per unit of bait ranged from 68.7 kg (August) to 154.4 kg (April) and averaged 108.7 kg for the year. In the tuna fishing from schools associated with flotsam the catch per unit of bait was found to be much higher (260.6 kg). Regression analysis between month-wise tuna catch and bait fish catch showed that the 'r' value was 0.82, indicating high relationship between the two.

Based on the results of the exploratory survey of live bait from Lakshadweep together with the detailed qualitative and quantitative distribution maps of tuna live-baits, their abundance in the Lakshadweep Island and their biology are being studied.

Resource characteristics of pomfrets (FB/PR/5.4)

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Investigations were continued at Veraval, Bombay, Karwar, Mangalore, Calicut, Cochin and Puri.

In the Bombay waters the pomfret fishery was poor. At Satpati and Bassein (Bombay) the catches comprised exclusively of the silver pomfret. At Satpati gill nets landed 319.4t of pomfrets recording a decline of 20.9% over that of the previous year. At Bassein, the dol net landings totalled 143 t showing a fall of 31.7% over the last year's catch. In the dol net catch *Pampus argenteus* ranging from 40 to 200 mm were recorded. Juveniles (70-80 mm) were caught in May and October thereby indicating the probable time of spawning. A length range of 110-320 mm was recorded in the gill net catches and the dominant modal group ranged from 190-270 mm.

At Veraval an estimated catch of 72.5 t of pomfrets was recorded from December onwards. Trawl nets and gill nets were mainly used. *P. argenteus* was dominant followed by *Parastromateus niger* and *P. chinensis*. The length range of *P. argenteus* and *P. niger* recorded in the catches were 130-299 mm and 110-439 mm respectively. The proportion of males to females in *P. argenteus* and *P. niger* were 36.8 : 63.2 and 78 : 22 respectively.

In the Karwar area the estimated catch was 115 t, up by a three-fold on the previous year. Purse seines and trawls contributed to the total catch with 90.5 t (79.3%) and 24.5 t (20.7%) respectively. *P. argenteus* showed a size range of 80-249 mm with modal values around 200-220 mm. *P. niger* ranged in size from 60 mm to 209 mm with modal values around 150-180 mm.

At Mangalore the fishery for pomfrets totalled 280 t. Drift gill net, trawls and purse seines were the gears operated and their contribution to the total catch was 28 t, 49 t and 203 t respectively. Drift gill net landed almost exclusively (99%) the black species, its CPUE being 66 kg. In the trawl, the silver and the black species formed 31.7% and 65.6% respectively of its landings. *P. niger* with a size range of 120 - 349 mm, and modal groups of 160, 190 and 220 mm formed the bulk of the catches.

At Malpe, a subsidiary centre of Mangalore 23 t of silver pomfrets and 323 t of black pomfrets were landed. Drift gill nets, trawlers and purse seiners accounted for 30.5 t, 17.9 t and 295.6 t respectively of the total. The silver species formed more than 75% of the trawler catches whereas the black species formed 98% of the gill net and purse seine catches. The CPUE of the purse seine was 32.7 kg and that of the drift gill net 6.2 kg.

At Vellayil (Calicut) the estimated catch amounted to about 104 t, the drift net alone contributing 73.6% followed by pattankolli vala (17.3%). *P. niger* contributed 98% while catches of *P. argenteus* were negligible. *P. niger* showed one dominant mode at 230 mm and two minor modes at 180 mm and 330 mm. The percentage of males and females were 61.3 and 38.7. Fish with developing gonads formed 84% and spent fishes were 5.3% while the rest were indeterminates. The percentage of *P. argenteus* males and females were 85.7 and 14.3 and the fishes were in developing stages. The total gill net catches of pomfrets at Pantakota (Puri), was 141 t. The third quarter accounted 56.1% of the total landings and the annual CPUE was 2.9 kg. *P. argenteus* dominated the catches.

Estimation of fishery and resource characteristics of oil sardine (FB/PR/9.1)

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The oil sardine (Sardinella longiceps) declined drastically with an estimated production of 3812 t as compared to 30806 t of the previous year. This decline appeared to be related to the delay and decrease in the recruitment of 0-year class at the southern centres. A considerable decline in the fishing effort was also observed during the year compared to that of the preceding year.

The fishery yielded a maximum catch of 2132 t at Mangalore and a minimum of 3 t at Vizhinjam. The maximum catch rate was recorded at Goa and showed a declining trend from the north to south. There was an increased abundance of oil sardine at the northern centres towards the close of the year. Purse seine was the principal gear employed at most of the centres while at Calicut, pattankolli vala and at Vizhinjam gill nets accounted for the bulk of the landings. The fishing was conducted mainly in the 6 — 10 F area off the southern centres and in 11-20 F area off the northern centres.

A comparative account of the catch and effort, age composition, sex ratio and maturity stages of this species has been drawn out for the southern and northern centres independently. An overall picture of the fishery is presented.

Studies indicated that the fishery was mainly sustained by the 2-year and 1-year old fish at most of the centres. The bulk of the landings at the major centres was contributed by the 0-year olds (94.7%) and 2-year olds (3.6%) at Goa, by the 2-year olds at Karwar (75.5%) & Mangalore (84.1%), by the 0-year olds (57.8%) and 1-year olds (26.7%) at Calicut and mainly by 1-year old fish (64.4%) at Cochin (Table-1). The recruitment and contribution of 0-year class to the fishery was significantly low during the year, at most of the southern centres at the beginning of the season, which probably accounted for the failure of the fishery. The secondary peak in recruitment of juveniles during November-December at the northern most centres like Goa and Karwar did contribute to the improvement of the fishery. It was estimated that about 31.4 millions of juveniles (60-95 mm) were landed by purse seines at Goa during November-December with the peak abundance (25.2 million) in November 1986.

Studies on the sex-ratio and maturity indicated that females were generally dominant in the catches at Calicut and Mangalore whereas males predominated at the other centres. Gravid fish occurred in abundance during April-July at the southern cen-

TABLE - I

Relative abundance (NO/UE) of different age classes of oil sardine at observation centres during the year 1986-'87

Centre	Fishing gear Non-selective	Relative abundance of age classes 0-year	1 year	2 year	3 year (+)
Goa	Purse seine	19649	286	759	66
Karwar	Purse seine	313	205	1779	59
Mangalore	Purse seine	337	162	2986	64
Calicut	Patten kollivala	294	136	72	7
	Nethavala	589	0	0	0
Cochin	Purse seine	803	1830	207	0
Vizhinjam	Boat seine	0	0	0	0
TOTAL		21985	2619	5803	196
Percentage		71.8	8.6	19.0	0.6

tres and during September-December at the northern centres. A similar trend in the abundance of spent fish in time and space was also observed. The dominance of spent fish during November-January, off Karwar and Goa, indicated the extension of the breeding period till October-November at the northern centres.

Studies on the assessment of stock at Cochin (1980-85) indicated that the MSY of the oil sardine stock off Cochin and Kerala was 12,500 t and 150,000 t as against the average annual yields of 10,340 t and 123,620 t respectively. Further increase in the rate of exploitation (0.65) by the purse seines may not result in any significant increase in the production. The study further showed that an increase in the length at first capture (Lc) to 145 mm at the present rate of exploitation would yield higher production.

Evaluation of the fishery and resources of lesser sardines (FB/PR/9.2)

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The lesser sardine fishery along the coasts of India was fairly good in spite of the set back at Mangalore and Karwar during the first half of the year. A noteworthy feature of the year's fishery was the increasing emphasis of gill net along the east coast and Vizhinjam on the west coast. Purse seine contributed to the fishery along the coasts of Mangalore, Karwar and Goa. Other gears used included boat seines, shore seines and hooks and line. Almost all the catches were taken at depths of 6-10 fathoms. Several species appeared in the fishery. *Sardinella gibbosa* (3.5-19.5 cm) were landed in good quantities at many of the centres. The smaller fish were caught by seine nets at Vizakhapatnam, while larger fish were recorded from Tuticorin, Vizhinjam and Karwar. Females were slightly more in number than males. Indeterminates also formed a good portion. All the stages of gonad development were noticed with fish with developing stages dominating followed by fish in gravid condition. Other species reported in the lesser sardines fishery were *S. albella, S. dayi, S. fimbriata, S. sirm, S. clupeoides, S. sindensis* and *S. brachysoma.*

At Vishakapatnam 281.8 t were landed. The major gear employed were gill nets, boat seine and shore seine. *S. fimbriata* formed the dominant species supported by *S. gibbosa* and *S. longiceps.* The size group 4.0 - 18.0 cm supported a good percentage of the *S. fimbriata* caught. The fishes were available in good proportion in the catches at the outer harbour throughout the year. Sexes were more or less equal and all the adult fish observed had gonads in the 'resting' stage.

The landings at Madras were 281.6 t. *S. gibbosa* was the dominant species, followed by *S. sirm* and small quantities of *S. fimbriata.*

The highest landings were reported from Tuticorin (3,760 t). *S. gibbosa*

formed the main bulk followed by *S. sirm, S. albella, S. dayi* and *S. clupeiodes.*

The production of lesser sardines at Vizhinjam was estimated as 142 t. Over 80% of the catch was composed of *S. gibbosa, S. albella, S. sirm,* and *S. sindensis. S. sirm* recorded ranged from 16.5 - 20.5 cm. During the 1st half of the year females were more in number than males while during the later half males were more. Fish in the 'resting', developing and spent stages were observed. The size range of *S. sindensis* was 12.5-18.5 cm. Males outnumbered females and all were in the developing stages of maturity.

At Mangalore, the landings were 943 t. Over 98.0% of the fishery was composed of *S. gibbosa & S. fimbriata. S. brachysoma* formed the rest and ranged from 13.0 cm to 18.0 cm. Females were more than males. Fish with developing and gravid gonads were recorded.

At Karwar 215.7 t of lesser sardines were landed. *S. gibbosa* ranked first in abundance. Other species recorded included *S. albella, S. dayi* and *S. fimbriata. S. albella* (10-17.5 cm) were observed in purse seine catches. Fish with developing and spent gonads were noted.

At Goa the catches were estimated as 835.2 t. *S. albella* was the dominant species followed by *S. dayi* and *S. fimbriata. S. albella* ranging from 10.0 - 17.5 cm were noticed in the purse seine catches. Fish with developing and spent gonads were recorded. *S. dayi* with length range from 10.0-16.5 cm were reported. Immature, developing and spent fish were noticed.

Evaluation of the resource characteristics of anchovies (FB/PR/9.3)

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Investigations were carried out on *Coilia* sp. at Bombay and on *Stolephorus* sp. (whitebait) at the other centres.

An estimated catch of 357.2 t of *Coilia* sp was landed by dol nets at Bombay. The monthly catch rate varied between 3.2 kg and 10.6 kg per haul with the overall average at 5.9 kg/haul. The length range was 40-200 mm with the dominant size at 100-150 mm length. Juveniles occurred in good quantities during May-October. Gravid and spent fishes occurred during July and October-January. Most of the gonads examined were in the developing stages. Fish caught both during day and night had mostly half to full stomach and food comprised mostly of ostracods and copepods.

The whitebait landings at Mangalore was 1304 t. Purse seines contributed to 95% of this catch and the rest by trawl nets. Whitebait was available to purse seines during April, November and December, whereas trawlnets landed whitebait during April; May and November-February. On the whole the November-February period accounted for 95% of the catch. The annual catch rate of purse seine was

124 kg. and that of trawl net was 13.5 kg.

At Malpe (near Mangalore) the whitebait landings were monitored from September 1986. Whitebait was available to purse seines during November, December and February. The catch was 1837 t and the catch rate 505 kg. The catch by trawlers was 49.7 t with a catch rate of 2.87 kg. Adult fish of *S. devisi* and *S. bataviensis* comprised the catches. Gravid and partially spent fish were common. Males were dominant in the catches. In the catches by indigenous gear at Baikampadi and Ullal (near Mangalore), *S. macrops* comprised 90-100% of the white bait catch, and *S. bataviensis* formed the rest.

At Cochin 597 t of whitebait were landed. The entire catch was by shrimp trawl, with the catch rate of 15.5 kg. *S. bataviensis* (75%) and *S. devisi* (24%) were the dominant whitebaits. The former ranged in size from 50 - 105 mm with the dominant sizes at 60-70 mm and 85-95 mm. Juveniles were dominant during April-June. The bulk of the fish had developing gonads. Sex ratio was equal. *S. devisi* ranged in size between 45 mm and 95 mm with the dominant sizes between 60-85 mm. Juveniles were dominant during April-June and January. The bulk of the fish had developing gonads. Males were predominant.

At Vizhinjam 535 t of whitebait were caught. The catch rate was 15.88 kg. The bulk of the catch (95.5%) was landed by boat seine and the rest by gill net (4.1%) and shore seine (0.4%). *S. bataviensis* formed the bulk (73.7%) followed by *S. devisi* (18.3%), *S. buccaneeri* (4.8%) and *S. andhraensis* (3.2%). *S. bataviensis* dominated the catch this year while it was *S. buccaneeri* during the last year and *S. devisi* in the year before last. Fish in the size ranges of 50-95 mm were seen in both, *S. bataviensis* and *S. devisi* while it was 55-90 mm in *S. buccaneeri*. The dominant size ranges were 75-85 mm, 60-85 mm and 75-85 mm for the three species respectively. Fish with gonads in advanced stages of maturity were observed during June to August. Females were dominant among *S. bataviensis* and *S. buccaneeri* while the sex ratio was equal for *S. devisi*. The stomachs of *S. bataviensis*, *S. devisi* and *S. buccaneeri* examined were empty, half full and full respectively.

The whitebait fishery at the Tuticorin centre presented a totally different picture compared with that of many other centres. *S. bataviensis* and and *S. devisi* generally formed the bulk of the landings both in shrimp trawl and indigenous gear at many other centres but *S. indicus* (66.5%) and *S. bataviensis* (30.4%) formed the bulk at Tuticorin. *S. devisi* (1.3%) *S. heterolobus* (1.5%) and *S. commersonii* (0.3%) accounted for the rest of the catch. Of the 83 t of white bait landed at this centre, the shrimp trawl contributed to the bulk (67%) and shore seine the rest. Fish in the size ranges of 45-150 mm and 55-150 mm were available among *S. indicus* and *S. bataviensis* respectively. About 84% of the

catch (by number) for the former species and 47% for the latter comprised of juveniles. Fish in advanced stages of maturity were not seen in both the species.

At Madras (Kasimedu) whitebait catch by shrimp trawl amounted to 47.3 t with the catch rate at 1.5 kg. *S. bataviensis* (79%) and *S. devisi* (21%) comprised the catches. Fish in the size ranges of 50-80 mm and 72-100 mm respectively were available in the two species, and all the adult fish had developing gonads.

At Kakinada a total of 1158 t of whitebait was landed by shrimp trawl. The bulk (72%) of the catch was during April-June and January-February with the catch rates ranging between 25.5 kg and 54.7 kg. During the remaining period the rates varied between 10 and 25 kg. Though *S. bataviensis* formed the dominant species (41%), *S. devisi* stood third (15.9%) at this centre. The other species were *S. commersonii* (23.4%) *S. macrops* (15.0%), *S. indicus* (4%) and *S. andhraensis* (0.5%). The lengths of *S. bataviensis* ranged between 40 and 119 mm and that of *S. devisi* between 45 and 94 mm. Juveniles formed the bulk of the catches in the former and adults in the latter species. Fish with gonads in 'resting' and developing stages dominated the catches of both the species. Sex ratio was equal in *S. devisi* but males were dominant in *S. bataviensis*.

At Visakhapatnam the catch was 166 t. The bulk of this catch (95%) was by shrimp trawl followed by boat seine (4%) and shore seine (1%) with the overall catch rates of 0.55 kg/hr, 1.67 kg/net and 7.7 kg/net respectively. Though boat seines were operated almost throughout the year whitebait occurred only during April, May and July to September. *S. bataviensis* formed the dominant species in all the three gears. On the whole it formed 81% of the whitebait catch followed by *S. devisi* (18.1%) and the remaining by the other three species. *S. devisi* occurred in the size range of 45-95 mm with dominant sizes between 60 and 80 mm. Fish with advanced gonadal maturity were available almost throughout the year. Sex ratio was equal. Most fish had full stomachs. *S. bataviensis* occurred in the size range of 40-130 mm with the dominant size ranging between 60 and 85 mm. Fish with gonads in advanced stages of maturity were available almost through out the year. The sex ratio was equal. The stomachs were full or partially full.

Evaluation of the fishery and resources of mackerel (FB/PR/9.4)

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Investigations were carried out at all the centres. There was a general decrease in the landings as compared to that of last year. The bulk of the purse seine landings were taken from the 11-20 fathoms depth while good catches of trawl nets were from the 6-10 fathom region.

The landings at Karwar by purse seine was 970 t. It was maximum dur-

ing the Oct.-Dec. period (68.24%) followed by July-Sept. period (30.93%). A total of 3322 purse-seines were operated this year. The sizes of mackerel ranged from 155-265 mm. The ratio of males and females were 48 : 52.

Mackerel landed by purse-seine at Mangalore was 8332 t and that by trawl net was 50 t. September and October registered heavy landings of 50.45% and 43.83% respectively. The number of purse-seines operated during the year was 9963. At Mangalore young fish ranging from 65 - 235 mm were taken by purse seines in April. The sizes ranged from 65-265 mm. The percentage of males and females were 48 and 51 while 1% of the fishes were indeterminate ones. Fishes belonging to stages I to VIII except VI were present.

At Calicut 497 t were landed. The contribution by pattankolli vala was 65.10% and ayilachala vala 34.58%. The maximum catch (52.03%) was during September. Young fish occurred in the catches of pattenkolli vala in August. The size of mackerel ranged from 65-280 mm. The percentage of males and females were 46 and 50 while 4% of the fishes were indeterminate ones. Gonads of fishes examined belonged to the 'resting', developing, gravid and spent stages.

At Cochin the landing was 1507 t. Purse-seines contributed 96.92% of the catch followed by drift net 1.76% and trawl net 1.32%. The number of purse-seine operated during the year was 1920. Young mackerel were recorded in the catches by purse-seine and the sizes ranged from 45-85 mm in April. The percentage of males and females were 48 and 50 while 2% of the fishes were indeterminate ones. Fish belonged to stages I to VIII except VI. A few partially spent and spent but recovering ones were present.

The landings at Vizhinjam were 293 t. Landings by mechanised drift netters were 65.8% followed by non-mechanised drift netters 19.18%; mechanised hooks and line 7.79%, non-mechanised hooks and line 2.5%, konchu vala 4.05%, boat seine 0.52% and shore seine 0.09%. The size ranges of fishes caught in mechanised drift nets were 210-250 mm. Size ranges of 120-280 mm were present in the catches by mechanised hooks and line. In non-mechanised hooks and line mackerel was present in the size range 210-275 mm. A small quantity of young mackerels (55 mm and above) were obtained in the shoreseine catches. The sex ratio was 1 : 1. Maturity stages I, 'resting', developing, gravid, partially spent and fully spent ones were noted.

During the year there were unusually heavy landings of 1093 t at Madras. The catch per unit effort of edavalai (bag net) and trawl nets were 619.4 and 3.9 kg respectively. The length of the fishes ranged from 110-235 mm. The ratio of males and females was 51 : 49 and consisted of maturing and spent fish.

At Panjim, purse seines landed 234 t with 53% of the total catch being taken in November. The size ranged from 120-155 mm. Females were more in the catches and fish belonged to the stages 1, II, IIb and IV. Spent

but recovering ones were also recorded.

Mackerel landings at Keelakarai, Pamban in Palk Bay and Dhanuskodi amounted to 43.3 t, 780 t and 289 t respectively. The size ranged from 145-275 mm. The percentages of male and female in the catches by drift gill net and shore seine were identical i.e. 42 and 58. Partially and fully spent fish were present in the catch apart from fish belonging to stages I to VI.

At Kakinada landings by trawl net was 199.3 t while uppada gill nets landed 46.1 t. The size of mackerel from trawls ranged from 180-230 mm and from gill net 180-225 mm. The percentage of males and females was 40 and 60, with fish belonging to I to VII stages except VI.

Bottom set gill net, boat seine and shrimp trawlers together landed 78.8 t at Visakhapatnam contributing 48.3, 28.5 and 23.2% respectively. The sex ratio of males and females was 49 : 51. Developing, partially spent and fully spent fish were recorded.

From the relative abundance of the different age classes at different centres, it is observed that the one year class sustained the fishery to the extent of 66.14% followed by 2 year class 18.96% at most of the centres. (Table II).

Evaluation of the fishery and resources of seer fish (FB/PR/9.5)

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TABLE II

Number of mackerel per unit of effort in different year classes during 1986-'87

Place	Gear	Age Class				
		0 year (159 mm)	1 year (169-229 mm)	2 year (230-269 mm)	3 year (270 mm)	Total
Karwar	Purse seine	2	1297	911	38	2248
Mangalore	Purse seine	522	11353	1435	40	13350
Calicut	Pattankolli	896	387	115	2	1400
Cochin	Purse seine	1918	4028	2293	106	8345
Vizhinjam	Shore seine	91	7	1	...	99
Panjim	Purse seine	205	262	268	...	735
Mandapam	Shore seine	24	179	7	...	210
Visakhapatnam	Boat seine	111	36	...	...	147
TOTAL		3769	17549	5030	186	26534
Percentage		14.20	66.14	18.96	0.70	...

A total of 101 t were landed at Mangalore by mechanised drift gill netters. The landings composed predominantly of *Scomberomorus commerson* (76.25%) and *S. guttatus*. The size range of *S. commerson* was 425-1190 mm and the fishery was supported by the size group of 400-925 mm. The spotted seer recorded ranged from 375-525 mm and the fishery was supported by the size group 425-475 mm.

At Malpe (Mangalore) 220.8 t were landed by mechanised drift gill netters. The landings were composed mainly of king seer 66.3% followed by the spotted seer. The size ranges of king seer and spotted seer were 325-1225 mm and 325-575 mm respectively and the size groups supporting the fishery were 475-875 mm and 375-475 mm respectively.

At Vellayil near Calicut 237.7 t of seer fishes were landed by drift net, ozhukkuvala and mackerel gill net, ayilachalavala. Drift net was the major gear which accounted for 236.9 t. The king seer constituted 99.5% of the catches followed by the spotted seer. The size ranges and size groups that supported the fishery of the king seer were 400-1075 mm and 525-725 mm respectively.

The seer fish landings at Cochin were estimated as 772 t by drift nets. The king seer comprised 98.2% followed by the spotted seer. The size range and size group that supported the king seer fishery were 375-1275 mm and 675-825 mm respectively.

At Vizhinjam 86.4 t of seer fishes were landed by drift net and hook and line units. *S. commerson* was the dominant species recorded.

At the three centres of Tuticorin i.e., fishing harbour, Punnakayal and north landing centre the gears operated were trawlnet, drift gill net and hook and line respectively. The catches were 148 t, 30 t and 7t respectively with *S. commerson* contributing more than 91% of the catch.

At Kasimedu, Madras 187.6 t of seer fishes were landed by drift gill nets, trawls and hooks and line. Drift nets operated from mechanised boats accounted for 79% of the total yield followed by trawl (20%) and hooks and lines (1%). Spotted seer comprised the bulk of the trawl catch followed by the king seer.

Evaluation of the fishery and resources of Bombay duck (FB/PR/9.6)

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Investigations were continued at Veraval, Bombay and Cochin. At Satpati the estimated catch was 2996.8 t with a stock density of 49.7 kg/haul. The primary mode was observed at the 45-75 mm size range. The exploitation rate was found to be 0.38 and total instantaneous mortality co-efficient estimated showed convergence at 2.0. The catch at Bombay (Arnala and Pachubunder) was estimated to be 1820.5 t with a catch rate of 34.16 kg per haul at Arnala. The maximum effort was directed at a depth zone of 0-10 metres during September-December. At Pachubunder, the total landings of

Bombay duck was estimated to be 3773 t with a catch rate of 32.11 kg/ haul. The estimated number of recruits entering the fishery at Arnala was 260.0779 x 10^6 and at Pachubunder 539.0071 x 10^6. The L was found to be 0.90.

The Bombay duck catch at Versova was estimated as 1119 t with a catch rate of 15.33 kg/haul. The size supporting the fishery ranged from 44 - 329 mm. The 150-164 mm and 210-224 mm size groups were dominant. The value of Z obtained by two different methods were 1.46 and 2.33.

At Rajpara a total of 10,823 t of Bombay duck were landed forming 63% of the total catch and at a catch rate of 94 kg per haul. Though fishes of the sizes range 30 to 330 mm were present in the catches, size groups 135-150 mm and 60-75 mm were dominant. About 54% of the females were gravid.

Evaluation of the fishery and resources of carangids (FB/PR/9.7)

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Investigations were continued at Veraval, Cochin, Vizhinjam, Tuticorin, Mandapam and Visakhapatnam. The fishery showed considerable improvement in all the centres except Veraval as against the previous year.

At Veraval catches landed by trawlnets and drift gill nets totalled 109 t. The catches declined by 57% as compared to the catches of the corresponding period last year. The trawlers as usual accounted for the bulk (83.2%) of the catch.

Carangoides malabaricus (21.6%) *Decapterus russelli* (20.6%), *Megalaspis cordyla* (17.8%), *C. chrysophrys* (15.8%) *Alepes djedaba* (11.3%) were important carangids landed by trawlers while *M. cordyla* (47.0%) *C. chrysophrys* (23.2%) and *A. djedaba* (15.1%) were dominant in the catches of drift gill nets.

The length of *C. malabaricus, C. talamparoides, M. cordyla* and *A. djedaba* in the fishery ranged from 120 - 274 mm, 135 - 264 mm, 230 - 370 mm and 200 - 290 mm respectively. Males of *C. malabaricus, C. talamparoides* and *A. djedaba* predominated over females. December to February appeared to be the spawning season for the above three species. The feeding was moderate in *C. malabaricus* while *C. talamparoides* and *A. djedaba* were mostly, poorly fed.

At Cochin an estimated 845.7 t was landed. Purse seine accounted for 51.5% of the catch followed by trawlnet 37.3% and drift net 11.2%. The catches were 4.5 times that of the corresponding period last year. The catches of purse seines, trawlnets and drift nets improved by 14, 4.3 and 1.2 times over that of the corresponding period last year.

A. djebada (69.0%) and *M. cordyla* (21.7%) were dominant in the purse seine catches while *Caranx kalla* (66.4%) *D. russelli* (12.4%) and *Atule mate* (9.8%) were important in the catches of trawlnets. *M. cordyla*

(44.2%) and *A. djedeba* (42.5%) together accounted for the bulk of the drift net catch.

The length of *A. djedaba* ranged from 180 to 240 mm in drift net catches while it varied between 80 and 360 mm in trawl net catches. Two modal groups were present in the fishery. The first group grew from 90 mm in January to 270 mm in November showing a growth of 180 mm in 10 months. The second group grew from 170 mm in January to 290 mm in October showing a growth of 120 mm in 9 months.

The length of *M. cordyla* ranged from 260 - 360 mm in trawl net catches and 280 - 400 mm in drift net catches. At least two modal groups could be seen in the fishery. The first one grew from 212 mm in July to 250 mm in October showing a growth of 40 mm in 3 months while the second one moved from 290 mm in January to 320 mm in October showing a growth of only 30 mm in 9 months. The length range of *A. mate, D. russelli* and *C. kalla* were 120-240 mm, 100-200 mm and 80-160 mm respectively.

At Tuticorin fishing harbour an estimated catch of 1473.1 t was landed by trawlers contributing 97.7% and by drift gill nets at Punnakayal and North Landing Centre accounting for 1.7% & 0.6% respectively. The trawl catches this year increased one and a half times over that of the corresponding period last year while the drift net catches at Punnakayal doubled.

Selaroides leptolepis (29%) was the dominant species in the trawl net while *Caranx carangus* formed 5.3%. The bulk was contributed by *Caranx* spp. (37.4%) and other carangids (28.3%). *Chorinemus lysan* (39.4%) and *C. carangus* (11.8%) were the dominant species landed by drift nets at Punnakayal.

At Vishakapatnam an estimated catch of 134 t of carangids was landed by shrimp trawl. The catches were more than twice that of the corresponding period last year.

Decapterus dayi in the fishery ranged from 90-205 mm. Two distinct modal groups representing 0-year and 1-year were seen. Growth studies indicated that *D. dayi* grew to 140 mm at the end of 1st year and 220 mm by the end of 2nd year. The size at maturity was observed to be 125-130 mm. *D. dayi* fed mainly on fish larvae and *Acetes* sp.

M. cordyla examined for growth studies varied between 80 mm and 365 mm. The progression of various modal groups indicated that these represented 4 year classes of this fish. The length at maturity appeared to be at 240 mm. Crustaceans like *Acetes* sp., *Solenocera* sp. and fish larvae appeared to be the preferred food.

At Mandapam the landings totalled 134 t of which trawl nets constituted 84.3% and shore seines 15.7%. *S. leptolepis* dominated the landings of both trawlnet (74.4%) and shore seine (67.66%). The trawl landings showed an increase of 5.6% over that of the previous year. The shore seine catches at Dhargavalasai improved by 75% over that of the previous year.

The size of *S. leptolepis* ranged between 95-170 mm in the trawl landings and 20-150 mm in the shore seine landings. There was recruitment of new broods into the fishery during April-May at modal lengths ranging between 37-52 mm. Maturing fish were observed during August-February while partially spent fish were seen during October-November and January-February suggesting the possibility of prolonged spawning.

At Vizhinjam an estimated 1200 t of carangids were taken, forming 11.8% of the total landings. Boat-seines contributed to the bulk (41.8%) followed by hooks and line (26.2%) and drift gill nets (19.6%). Carangids were densely distributed in the 15-20 fathoms depth range. *D. dayi* (46.2%) and *Selar crumenophthalmus* (19.24%) were the important carangids landed by all the gears.

The size of *D. dayi* in the catches of hooks and lines ranged between 115-229 mm. New broods entered the hooks and line fishery during December-February with modal lengths of 127-147 mm. Young fish with the modal group at 87 mm entered the boat seine fishery in August. The length of *Selar mate* ranged from 175 mm to 314 mm. Two modal groups probably representing two year-class were represented in the fishery.

Studies on the fishery and resource characteristics of the Indian shad, *Hilsa ilisha* in West Bengal and Orissa coast (FB/PR/10)

S. Reuben, S. K. Dharmaraja, S. S. Dan

Hilsa landing survey was carried out at four centres namely Diamond Harbour, Frazer Gunj and Digha in West Bengal and Talsari in Orissa. Marine landings of hilsa improved at all centres as compared to that of the last year. Landings from the Hooghly river at Diamond Harbour totalled 25 t. Two types of gill nets namely chandijal with a mesh size of 9-12 cm and ilishjal with a mesh size of 5-8 cm were chiefly used in hilsa fishery. Two types of encircling nets namely jangal and kachal were also used during winter months besides shoreseine.

An estimated 74.9 t of hilsa was landed at Diamond Harbour centre. Hilsa formed 21.0%, 27.5% and 97.9% in the catches of gill net, jangal and kachal respectively. Of the total hilsa catches at Diamond Harbour the encircling nets (Jangal 31.4%, and kachal 36.0%) together landed more than half of the catch. Gillnet catch rate was the highest, being 60.72 kg/unit. The catch rate of jangal and kachal nets worked out to 1235.9 kg/unit and 6000 kg/unit respectively.

Sample observations at Fraser Gunj showed that the catches of gill net worked out to 5.23 kg/hr. Hilsa landings at Digha centre totalled 214.8 t. Mechanised gillnet landings contributed to the bulk (97.3%), non-mechanised gill nets (2.6%) and shore seines (0.1%).

An estimated 22 t of hilsa was landed at Talsari. The mechanised gill nets landed the bulk of the catch. Preliminary analysis of length frequency has shown that at least five distinct

groups of hilsa occurred in the fishery. There were four modes in October at 244 mm, 264 mm, 294 mm and 310 mm, all representing new recruits into the fishery. There was another set of modes distributed at 350 mm and 380 mm in August/September/October respectively in the second group of hilsa. The third group was represented by the modes at 430 mm during August-September and the fourth group by modes at 480 mm and 490 mm in August and September. While the first and third groups appeared to represent hilsa that were spawned during monsoon the second and fourth groups represented results of the winter spawning. Yet another modal group representing older fish was observed at 530 mm. The observations at Diamond Harbour on the river fishery revealed the presence of both monsoon and winter runners in the fishery ascending the river.

Studies on eggs, larvae and young ones of commercially important fishes (FB/PR/11)

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The nearshore station at 15 m depth at Cochin was richer in fish eggs with the maximum in August (1203/m^2) which was a six fold increase over the corresponding period of last year. In July there was a good collection of oil sardine eggs (203/m^2) at the nearshore station which contributed to 5% of the total eggs during the year. In December also eggs belonging to *Sardinella* spp. were collected. Carangid eggs made up 66%, of the total collection during June-September period. Eggs of *Stolephorus* spp. and flat fishes were collected during the post-monsoon period and those of ambassids throughout the year.

Fish larvae were less in number with a mean value of 8/m^2 per haul. Of the total larvae collected 20% belonged to flat fish with the maximum number in September. 17% of all larvae were carangids, mainly caught during August to November. 13% belonged to ambassids and were present throughout the year. Clupeoids contributed to 14%, *Sardinella* spp. (June and December) contributed 4% and *Stolephorus* spp. (June, November and January) contributed 10%. Mackerel larvae contributed 6% (May, June, October and January). Larvae of sciaenids contributed 7%, gobids 3%, *Bregmaceros* sp. and *Mugil* sp. 2% each. Young fishes of *D. russelli* in the size range of 88-141 mm was the major group in the trawl net catches. *Saurida undosquamis* (142-167 mm) and *Nemipterus japonicus* (45-110 mm) followed in abundance. *C. kalla* (66-80 mm) and *Johneiops sina* (57-69 mm) were the next in abundance. *Nemipterus mesoprion* (77-100 mm) and *Platycephalus* sp. were found in small numbers. A few numbers of *Callionymus longicaudatus*, *Fistularia villosa* (165 & 198 mm) and *Pomadasys maculatus* were also observed. *Leiognathus elongatus* (41-75 mm) and *N. mesoprion* (80-105 mm) were the other groups observed.

Collections were made in 13-80/1C and 13-80/2C squares at 10 & 30 me-

tres depth. During Sepember 1986, *Caranx* sp. and *Saurida* sp. eggs were noticed from 30m depth at Madras. In February good numbers of *Stolephorus* sp. eggs were noticed both at 10m and 30m depths. From Nov. 1986 to February 1987 myctophid eggs were frequently observed in 10 to 30 m depth. Larval flat fishes and *Caranx* sp. were noticed in November and December. At Kasimedu (Madras) landing centre where commercial trawlers were operated, 32 species of young fish including 7 species of silver bellies and 7 species of sciaenids were recorded. One specimen of *Harpodon* sp. measuring 102 mm was recorded in December. Young oil sardine were collected at Vaithykuppam (Pondicherry) and they ranged from 82-107 mm.

At Veraval four main species of young fishes i.e., *Protonebea diacanthus Parastromateus niger* and *Pampus argenteus* and *Trichiurus lepturus* were obtained in trawlnets. Young *T. lepturus* dominated the ribbon fish (92.22%) while *P. niger* and *P. argenteus* young ones were scarce i.e., 2.94 and 1.74% respectively .Young *P. diacanthus* constituted 19.12% of the total *P. diacanthus* catch. *P. argenteus* measured upto 150 mm, *P. niger* upto 164 mm, *P. diacanthus* and *T. lepturus* upto 400 mm.

Young ones of Bombay duck landed at Bombay was estimated as 290.4 t with the catch rate of 55.7 kg per unit. The principal gear was dol net. The catch rate was high in May (116.0 kg) and low in December (4.5 kg). The occurrence of young ones varied between 2272 (December) to 37216 (November). The dominant size modes were 45-60 mm in April, October, November; 60-75 mm in December and January and 90-105 mm in September.

The study on trash fish from the trawl catches at Kakinada showed that crabs were the dominant group. *Apogon* spp. and stomatopods amounted to 16422 kg and 14,463 kg respectively.

Prawns, *Cynoglossus* sp., *Stolephorus* sp., eels, silver bellies, cephalopods, molluscs, *Pseudorhombus* sp., *Nemipterus* sp., gobiids, upenoids, *Lutianus* sp., scorpion fish, ribbon fish and *Platycephalus* sp., were the other groups present in order of their abundance.

In trawlnet landings at Calicut, juvenile fishes were about 685 t. The peak period was in February. Juveniles of *Cynoglossus* sp. dominated the catches forming about 55.7%. *Nemipterus* sp. and *Stolephorus* sp. were the other two major constituents forming 7.8% and 6.1% respectively of the total juvenile catch. Paithuvala landed 12.1 t of juveniles in December. Juveniles of *Leiognathus* sp. formed the major catch followed by *Cynoglossus* sp. and *Tachysurus* sp. In stake nets the total landings of young prawn and young fish were estimated to be about 38 t of which 66.9% was contributed by young prawns. 12.5 t of young fish were recorded. *Ambassis* sp. and *Stolephorus* sp. were the usual components of the sample. *Ambassis* sp. was present in the samples throughout the period but *Stolephorus* sp. was present between July and October and December. Juveniles of *Leiognathus* sp. and *Psettodes* sp. were also present.

Fish eggs were recorded at Tuticorin throughout the year. The maximum number of eggs (512) were recorded during the month of March '87. The monthly average number of fish eggs per haul ranged between 10 and 307. Few *Anchoviella* sp. eggs were collected in August. Fish larvae were recorded in all the months except April and May. A large number of larvae were recorded during March. The number of larvae per haul ranged between 4 and 80.

Assessment of stocks of fishes and prawns supporting the dol fishery along Maharashthra coast (FB/PR/12)

ALEXANDER KURIAN

Data from the four centres i.e., Dahanu, Kelwa, Bassein and Alibag revealed that Bombay duck and *Coilia* sp. formed the target species for the 15 mm mesh dolnet and pomfrets for the 25 mm mesh dol net. Since satisfactory progress was not achieved, the project was closed for the year.

Stock assessment of ribbon fishes (FB/PR/13)

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Investigations were continued at Kakinada, Visakhapatnam, Tuticorin, Bombay, Madras, Mangalore and Vizhinjam. *Trichiurus lepturus* contributed the major share among ribbon fishes in all the centres except Bombay. At the east coast centres, this species formed more than 90% of the catch.

At Kakinada, bottom trawlers contributed 1226 t with a CPUE of 4.2 kg. A total catch of 546.5 t of ribbon fishes were landed at Visakhapatnam with an average CPUE of 35.5 kg. At Madras an estimated catch of 195 t of ribbon fishes were taken by trawlers with an average CPUE of 4.4 kg. A total catch of 31 t were landed at Tuticorin by trawlers with a CPUE of 0.7 kg. 325 t of ribbon fishes were landed at Vizhinjam. Boat seines contributed 95% of the catches. Non mechanised drift net and hooks and lines contributed to the rest. At the Bombay-Sasson docks, shrimp trawlers caught 721 t with an average CPUE of 1.6 kg and at the Versova landing centre, 167 t was netted by dol nets with a CPUE of 21.3 kg.

The other species recorded at Visakhapatnam, Kakinada and Tuticorin were *Lepturacanthus savala, L. gangeticus, Eupleurogrammus muticus* and *E. glossodon*. At Bombay, dol net catch composed of *L. savala* and *E. muticus* and the size ranged between 67-900 and 240-640 mm respecively. At Visakhapatnam, *T. lepturus* recorded, measured between 150-779 mm length and at Kakinada the sizes ranged between 240-960 mm. At Madras only the smaller fishes were cuaght (200-499 mm) whereas at Tuticorin the sizes ranged between 475-874 mm. The sizes of the fish caught at Vizhinjam by boat seine ranged between 260-1109 mm, while hooks and line units brought bigger sizes ranging from 450-1139 mm.

Investigations on whales, dolphins and dugongs (FB/PR/14)

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202 dolphins and 8 dugongs were caught incidentally in the drift gill net along the Indian coast. Whales stranded were *Globiocephala macrorhynca* (2 nos.) *Physeter macrocephalus* (2 nos.) and *Balaenoptera borealis* (1 no). Of the 202 dolphins landed, 55 were *Delphinus delphis tropicalis* (23.6%); 117 were *Stenella longirostris* (61.6%); 24 were *Tursiops aduncus* (12.1%) followed by *Sousa chinensis* and *Neophocaena phocaenoides*. The south west coast contributed 197 numbers of dolphins out of which 123 were from Cochin and 27 were reported from Calicut. The east coast accounted mainly for the stranded whales. The dugongs were reported from Palk Bay and Gulf of Mannar. *Delphinus delphis tropicalis* occurred mostly in May, August-October and February. In the case of *Tursiops truncatus aduncus*

TABLE III

Length range (in cms.) of Dolphins, Whales and Dugongs along the Indian coast

Dolphins	100-149	150-199	200-249	250-299	300-349
Stenella longirostris	11	12	2	...	...
Sousa chinensis	...	...	2	...	...
Tursiops truncatus aduncus	...	1	7	1	...
Delphinus delphis tropicalis	7	14	2	2	...
Neophocaena phocaenoides	2	...	...	...	...

Whales	100-149	300-349	550-599	900-949	100-1049
Globiocephala macrorhynca	1	1	...	...	...
Physeter macrocephalus	...	...	1	...	1
Balaenoptera borealis	...	...	...	1	...

Dugongs	300-349
Dugong dugon	1

(length of 7 other dugongs not available)

91.6% of the occurrence was in September-November. The length of *Delphinus delphis* ranged from 103-260 cms, with dominant size groups of 150-199 cms. The gut contents of a *Delphinus delphis tropicalis* caught at Calicut showed 10 mackerels. One live dolphin *Delphinus delphis tropicalis* was observed in the Quilandy fish market on 17-2-87 (Male-length 1830 mm). The length range of *Stenella longirostris* was 135-230 cms and that of *Tursiops truncatus aduncus* was 150-267 cms. The length range of *S. chinensis* was 200-217 cms.

The length range of *G. macrorhynca* was between 140 and 302 cm whereas the length of *P. macrocephalus* ranged from 550 to 1000 cm. (Table III).

Two specimens of the shortfinned pilot whale *G. macrorhynca* stranded near Madras in July. One *P. macrocephalus* stranded near Pondicherry in December. *B. borealis* stranded in January.

Population studies by mark release experiments on commercially important prawns and fishes (CMFRI/IDP/16)

A. NOBLE

Tags were fabricated through a local firm at Cochin using celluloid instead of plastic sheets. A live fish holding net of 20 x 20 x 20' size was also fabricated for keeping the fish alive while tagging. Since the mackerel and oil sardine fishery were extremely poor, tagging experiments could not be conducted this year.

CRUSTACEAN FISHERIES DIVISION

Compared to last year the penaeid prawn catch by the trawlers increased at Bombay, Malpe, Calicut and Cochin, while it declined at Veraval, Karwar, Sakthikulangara and Tuticorin. It was more or less the same at the other centres. Prawn catch by the purse-seines at Mangalore was negligible. At Calicut the indigenous boat seines landed 4 times more prawns than the trawlers. An indigenous trawl net operated from sailed boats for catching juvenile *Penaeus semisulcatus* (75 mm) from the seagrass beds in the Palk Bay is likely to prove very detrimental to the prawn fishery of the region. An analysis of the prawn fishery of the north east region by the large trawlers based at Visakhapatnam revealed that the present fleet of 118 big trawlers exceeded the estimated limit of 105 trawlers that this region could support. Experimental shrimp trawling at Cochin with R. V. Skipjack revealed that the population of *Parapenaeopsis stylifera* which occupy the shallow regions (10-20 m) during the premonsoon and postmonsoon period, move to deeper waters (upto 60 m) during the monsoon season. The lobster catch increased by 80% at Veraval while there was a slight decline at Bombay. The crab and stomatopod landings in the Mangalore region registered an increase during the current year.

Under the culture fisheries, two species of prawns, *Penaeus latisulcatus* and *Penaeus canaliculatus* which were not so far cultivated in India were successfully grown at the Muttukad farm. The former species was induced to mature and spawn in captivity and the larvae grown to the juvenile stage. The second generation was grown in the farm. High production rates of *Penaeus indicus* (1200-1600 kg/ha in 5-7 months culture period) were obtained in pump-fed farms in the salt pan area of Tuticorin under hypersaline conditions (38-48 ppt). The indigenous technology for hatchery production of prawn seed, developed by the CMFRI has been accepted by the States of Kerala, Karnataka and Andhra Pradesh. The CMFRI provided technical assistance to these three States for establishing penaeid prawn hatcheries that could produce 8-10 million prawn seed (PL 20) per year. A successful trial hatchery run was conducted at Mopla Bay in Cannanore to test the feasibility of establishing a hatchery there. At Narakkal hatchery laboratory 3.1 million postlarvae of *P. indicus* were produced during the year. For the first time *Parapenaeopsis uncta* was reared from the eggs spawned in the laboratory to the postlarval stage at the Kovalam field laboratory.

Assessment of penaeid prawn resources (CF/RE/1.1.1.)

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MANISSERI, R. FOTEDAR, V. D. DESHMUKH, P. E. SAMPSON MANICKAM, M. RAJAMANI, D. B. JAMES, V. THANKARAJ SUBRAMANIAM, S. LALITHA DEVI, G. SUDHAKARA RAO and K. R. MANMADAN NAIR

Detailed investigations on the resource characteristics, exploitation and biological features of important penaeid prawns were carried out at Veraval, Bombay, Karwar, Mangalore, Calicut and Cochin on the west coast; Puri, Waltair, Kakinada, Madras, Mandapam Camp and Tuticorin on the east coast.

Penaeid prawn landings declined at Veraval, Karwar, Mangalore and Sakthikulangara on the west coast and at Tuticorin and Kakinada on the east coast. Considerable decline in the landings was observed at Tuticorin (80%) and Sakthikulangara (31%). Marginal improvement in the landings was recorded at Madras, Paradeep and Waltair. Substantial increase in the landings were seen at Malpe (37.5%), Calicut (41.3%) and Cochin Fisheries Harbour (150%) on the west coast. At Malpe, increased catches were obtained for *P. stylifera*, *P. indicus* and *M. affinis*. At Calicut, the post-monsoon prawn fishery was very active. At Cochin, the monsoon fishery for *P. stylifera* was extremely good. Table No. 1 shows the penaeid prawn landings by different gears in the marine and estuarine regions.

As compared to the previous year fishing effort increased at most of the centres on the west coast. At Malpe and Cochin Fisheries Harbour the effort increased to 50% and 37% respectively. At Calicut the decline was 32%. Fishing effort declined at most of the centres on the east coast, especially at Tuticorin (50%).

The catch rate was highest at Cochin (19.3 kg/hr) followed by Kakinada, (11.9 kg/hr), Saktikulangara (11.3 kg/hr) and New Ferry Wharf at Bombay (11.2 kg/hr). The catch rate was lowest at Mandapam (1.8 kg/hr) followed by Tuticorin (2.1 kg/hr), Waltair (2.2 kg/hr) and Madras (2.9 kg/hr).

Prawns were absent in the purse-seine operations at Mangalore. At Malpe, 4.2 t of *Metapenaeus dobsoni* were landed in November and February.

Indigenous gears

Indigenous gears landed good quantities of prawns at Mangalore Calicut, Tuticorin and Puri. At Ullal and Baikampady in Mangalore 'matabala' (miniature purse seine) landed sizeable quantities of prawns in July and August. Substantial increase in the landings by indigenous gears occurred at Calicut because of the unexpected yield of 502 t landed by 'pattenkollivala' mainly in July. Operation of 'disco' net at Puri resulted in a three fold increase in prawn landings, mainly *P. indicus*.

Estuarine prawn fishery

Estuarine and backwaters at Karwar, Calicut, Cochin, Kakinada and Puri yielded considerable quantities of prawns. (Table No. 1). Sluice nets

Table No. 1 Penaeid prawn landings at different Centres (April 1986 - February 1987)

Particulars	Veraval	Bombay New Ferry Wharf	Karwar	Tadri	Malpe	Mangalore	Calicut	Ponnani	Munambam
1. MARINE									
A. GEAR : *Trawl Net*									
1) Catch in tonnes	2001.0	9448	247	181	531	1170.2	127	126	741
2) Catch/boat trip (kg)	39.84	372.58	25.65	28.31	16.01	33.71	30.46	15.02	44.74
3) Catch/hour (kg)	4.20	11.16	5.13	5.66	2.71	4.35	9.27	3.0	10 72
4) Important species*	h,f,g,c	f,h,a,i,b,g	d,b,a;f;l	d,b,a	d,f,b,j	d,f,b,j	f,d,j	j,f,b,d	d,f,j
5) Productive months†	9,11,10,4	9,10,4	12,4,5	12,1,2	5,4,1,2	4,1,2	1,2,12,4	2,5,4,1	4,5,1,2
B. GEAR: *Purse seine*									
1) Catch in tonnes			6		4				
2) Catch/unit (kg)			279.2						
3) Important species			d		d				
4) Productive months			8,5		11,2				
C. *Indigenous Gears*									
1) Centre					Ullal (Mini purse seine)	Baikampady (Mini purse seine)	Vellayil (boat seine)		
2) Catch in tonnes					111	6	547		
3) Catch/unit (kg)					383.0	27.3	65.4		
4) Important species					d	d	d		
5) Productive months					7,8	7,8	7		
2. ESTUARINE									
1) Name of centre			Karwad (Sluice net)				Korapuzha estuary (stake net)		
2) Catch in tonnes			71				55		
3) Catch/unit (kg)			3.33				1.5		
4) Important species			d,b,l,j				d,b,j		
5) Productive months			1,2,12				5,4,12		

(Table No. 1 Contd.)

Particulars	Cochin Fisheries Harbour	Sakthi-kulangara	Tuticorin	Mandapam	Madras	Cuddalore	Kakinada	Waltair	Paradeep
1. MARINE									
A. GEAR : *Trawl Net*									
1) Catch in tonnes	3375	6787	104	847	632	362	3782	633	1435
2) Catch/boat trip (kg)	80.93	56.07	10.44	...	14.25	...	89.37	30.04	69.64
3) Catch/hour (kg)	19.31	11.25	2.09	1.81	2.85	3.32	11.89	2.20	11.12
4) Important species*	f,d,j	f,j,d	m,f,j,d	m,i,j,q	d,j,b	i,d,j,q	b,d,j,e	j,b,i,h,d,k	d,a,p;h;f;g
5) Productive months†	7,5,6,4	7,8,6,5,1	5,10,8,12	12,7,11,8	1,8,10,6	8,9,6,7	1,2,9,5	9,12,11,8	12,1,10,11
B. GEAR: *Purse seine*									
1) Catch in tonnes									
2) Catch/unit (kg)									
3) Important species									
4) Productive months									
C. *Indigenous Gears*									
1) Centre									Puri (Gill net)
2) Catch in tonnes									198
3) Catch/unit (kg)									3.5
4) Important species									j,a,k
5) Productive months									10,11,9
2. ESTUARINE									
1) Name of centre	Vypeen & Elamkunnapuzha (stake net)						S.V. Palem (Stake net & drag net)		Jadpur (Trap)
2) Catch in tonnes	356						241		41
3) Catch/unit (kg)	2.4						14.75		0.03
4) Important species	a,j,b						b,j,d,b		b,j,d,k
5) Productive months	7,9,8						1,11,12,9		

* IMPORTANT SPECIES : a) *M. affinis* (b) *M. monoceros* (c) *M. kutchensis* (d) *M. dobsoni* (e) *M. brevicornis.* (f) *P. stylifera* g) *P. hardwickii* (h) *S. crassicornis* (i) *Metapenaeopsis* spp. (j) *P. indicus* (k) *P. monodon* (l) *P. merguiensis* (m) *P. semisulcatus* h) *P. penicillatus* (o) *Trachypenaeus* spp. (p) *M. ensis* (q) *P. maxillipedo.* † PRODUCTIVE MONTHS : Calendar months.

Table No. 2 Percentage composition of penaeid prawns in the trawl fishery at various centres (Estuarine fishery in parentheses)

SPECIES	Veraval	Bombay New Ferry Wharf	Karwar	Tadri	Malpe	Mangalore	Calicut	Cochin Fish harbour	Sakti-kulangara
M. affinis	...	9.4	18.6	13.7	4.8	1.6	0.2		
M. monoceros	1.6	8.6	20.9	37.6	5.8	22.5	1.8	2.4	2.9
							(17.8)	(10.5)	
M. dobsoni	1.3		43.6	44.6	43.8	45.0	23.6	17.4	5.2
M. brevicornis		4.8					(66.4)	(64.6)	
M. kutchensis	9.0	2.6							
M. burkenrodi									
M. ensis									
P. stylifera	27.1	31.3	13.4	1.6	28.5	22.8	70.5	75.1	82.1
P. hardwickii	16.7	5.0							
P. maxillipedo									
P. uncta									
S. crassicornis	35.3	21.5							
P. longipes									
Metapenaeopsis sp.		9.3							
P. indicus				2.5	6.9	7.4	3.9	4.8	7.6
							(15.6)	(22.9)	
P penicillatus	3.1	2.7							
P. merguiensis			3.1						
P. monodon		0.3	0.4		0.2	0.7	(0.2)		
P. latisulcatus									
P. semisulcatus	0.7							(1.2)	
Trachypenaeus sp.									
Others	5.2	4.5						0.3	2.2
								(0.8)	

(*Table No. 2 Contd*)

SPECIES	Munambam	Ponnani	Tuticorin	Mandapam	Madras	Cuddalore	Kakinada	Waltair	Paradeep
M. affinis							4.4		18.5
M. monoceros	1.6	21.5	1.6		3.0	4.8	31.8 (59.6)	26.7	
M. dobsoni	63.8	8.6	8.3		46.3	22.4	13.5 (9.6)	7.4	23.4
M. brevicornis							10.5 (6.3)		
M. kutchensis									
M. burkenrodi				2.1					
M. ensis									16.5
P. stylifera	31.5	23.7	12.8	0.7					6.3
P. hardwickii									5.9
P. maxillipedo			6.4	5.0					
P. uncta			6.0	0.8		3.4			
S. crassicornis								8.4	
P. longipes								1.6	12.7
Metapenaeopsis sp.				9.4		46.3		9.7	3.6
P. indicus	3.0	41.8	18.2	6.0	9.9	7.7	13.4 (12.5)	30.7	
P. penicillatus									1.0
P. merguiensis									4.7
P. monodon	0.1	0.6			1.0	1.5	6.5 (4.6)	6.3	
P. latisulcatus			0.7						
P. semisulcatus		3.8	45.9	68.4	0.8	3.8	1.0	2.9	
Trachypenaeus sp				4.9		7.2		0.8	0.6
Others				2.7	39.0	2.9	18.3 (7.4)	5.5	6.8

(Karwar), stake nets (Korapuzha estuary, Cochin backwaters and Kakinada) and traps (Chilka lake) were the main gears employed. At Calicut the fishery showed a considerable decline whereas at Kakinada, marginal improvement was noticed. At Madras, post-larval index of abundance was used to predict marine prawn catch during different months. Percentage composition of penaeid prawns at various centres is shown in Table No. 2.

In the upper west coast, *P. stylifera, Solenocera crassicornis, M. affinis, Metapenaeus kutchensis, Metapenaeopsis stridulans* and *Parapenaeopsis hardwickii* were the dominant species. In the lower west coast major species were *M. dobsoni, P. stylifera, Metapenaeus monoceros* and *P. indicus*. Monsoon prawn fishery was almost exclusively supported by *P. stylifera*. Though *P. stylifera* and *M. dobsoni* were the dominant species at most of the centres in Kerala *P. indicus* and *M. monoceros* contributed to the bulk of the fishery at Ponnani.

In the upper east coast the fishery was largely supported by *M. monoceros, M. dobsoni, Metopenaeopsis* sp., *P. indicus, M. affinis, M. brevicornis* and *S. crassicornis*. At Paradip, *M. ensis, M. basbata* and *P. longipes* contributed to the minor fisheries. In the lower east coast the dominant species were *P. semisulcatus, M. dobsoni* and *P. indicus*. At Cuddalore, nearly 46% of the catch was accounted for by *M. stridulans* and taken by fish trawls during the July-September period.

In the Mandapam region, species composition of the prawn fishery in Palk Bay and Gulf of Mannar was characteristically different. Eventhough *P. semisulcatus* dominated in both regions, *Metapenaeopsis* sp. and *Trachypenaeus pesacadorensis* were the other important species in Palk Bay area whereas in Gulf of Mannar, *P. maxillipedo* and *P. uncta* were important.

Log data of large trawlers (23 m) operating in the north east coast during 1983-84 to 1985-86 was analysed as given below.

Year	No. of units	Fishing hours (in thousands)	Catch in tonnes (headless)	C/hr.(kg)
'83-84	55	144	2353	16.3
'84-85	60	139.9	2816	20.1
'85-86	76	184.9	3043	16.5

'Browns' comprising of *M. monoceros, M. ensis* and *M. affinis*, formed 62% of the prawns landed by large trawlers followed by 'whites' (29%) viz. *P. indicus, P. merguiensis* and *P. penicillatus* and 'tigers' (8%) viz. *P. monodon* and *P. semisulcatus*. 'Whites' occurred in shallow areas upto 40 metres, 'tigers' upto 60 metres and 'browns' upto 100 metres.

Based on swept area method the potential yield of prawns from the trawling grounds between Pentakota

and the Sunderbans was estimated as 6559 tonnes, which could support 105 large trawlers. The present fleet of 118 large trawlers at Vishakapatnam has exceeded this limit.

Nursery areas supported a fishery for *M. dobsoni*, *P. indicus* and *M. monoceros* at Calicut and Cochin whereas at Kakinada *M. monoceros* was predominant followed by *P. indicus* and *M. dobsoni*.

Size composition of the commercial species at various centres is given in Table No. 3. No significant difference was observed over the previous year. Females outnumbered males in most of the species, sometimes disproportionately high as in the case of *P. stylifera*, *P. hardwickii*, *M. dobsoni*, *M. brevicornis* and *S. crassicornis*. In the upper east coast mature females were generally high during November-February. In the lower east coast another peak was noticed in July-Septmber. On the west coast it was high during April-June, September and December - February. Growth parameters, mortality rate, and yield per recruit for *P. indicus* at Kakinada have been worked out. There seems to be scope for increasing the effort to increase the yield of this species. The lengths at first maturity for *P. indicus*, *P. monodon*, *M. monoceros* and *M. dobsoni* were estimated at 125, 182, 115 and 69 mm respectively at Kakinada. These species spawn throughout the year with 2 or 3 peaks.

Assessment of non-penaeid prawn resources (CF/RE/1.1.2)

D. B. James, Ravi Fotedar, V. D. Deshmukh, M. Aravindakshan and S. Lalithadevi

With an estimated catch of 978 t at an average catch rate of 39.8 kg/dol net unit, the non-penaeid fishery suffered a decline of 42% over that of the previous year at Navabundar (Veraval). At Bombay, the new observation centre New Ferry Wharf registered a catch of 901 t of prawns at the rate of 35.5 kg/boat by trawl nets and 168 t at the rate of 73.3 kg/boat by dol nets. On the east coast, Kakinada witnessed considerable improvement in the fishery by trawl nets with an estimated production of 1038 t at an average catch rate of 24.5 kg/boat. The peak seasons for the fishery were November-December at Navabundar and September at Bombay and Kakinada. *Acetes* spp. accounted for the major portion of the catch taken by the indigenous gears at Veraval and Bombay and the shrimp trawls at Kakinada. The trawl fishery at New Ferry Wharf was dominated by *Nematopalaemon tenuipes* (85%). *Exhippolysmata ensirostris* occupied the third position in the fishery.

At Veraval, about 21% of the females of *N. tenuipes* were berried, while at Bombay the percentage of ovigerous females was 70-80 during July to September. Studies on population dynamics of *E. ensirostris* in Bombay waters revealed the life span of the species to be 13 months. The annual standing stock was estimated as 69 t and the mean annual yield as 36 t.

Studies on coastal shrimp fishery by experimental fishing (CF/RE/1.1.8)

C. Suseelan, G. Nandakumar, K. N. Rajan, M. Rajamani, Ponseraimeten, P. E. Sampson Manickam, S. Krishna Pillai, S. Ramamurthy, V. Thangaraj Subramanian, K. G. Girijavallaban and G. Sudhakara Rao

Table No. 3 Size range in mm with dominant size in brackets; male (M), female (F) and all sexes (A)

Gear : Trawl net

SPECIES	Veraval	Bombay New Ferry Wharf	Karwar	Malpe	Mangalore	Calicut	Cochin Fisheries Harbour	Sakthikulangara
M. affinis		M 63-158 (118) F 63-193 (123)	M 66-115 (103) F 56-155 (113)					
M. monoceros		M 68-168 (123) F 68-208 (158)	M 61-135 (108) F 61-155 (123)					
M. dobsoni			M 56-100 (93) F 46-125 (88)	M 43- 88 (73-78) F 48-113 (93)	M 53- 98 (73) F 58-113 (93)	M 41- 95 (68) F 36-110 (88)	A 46-110 M (63-68) F (63-83)	A 41-105 (68-73)
M. brevicornis		M 43-113 (83) F 48-148 (103)						
M. ensis								
P. stylifera	M 68-113 (83) F 58-143 (93)	M 53-118 (83) F 63-138 (88)	M 56- 95 (88) F 46-115 (93)	M 53- 98 (68) F 53-118 (68)	M 58-103 (73) F 63-118 (78)	M 31-100 (73) F 31-125 (58)	A 41-125 M (73) F (73)	A 36-115 M (83) F (78)
P. hardwickii	M 48- 73 (63) F 58-128 (93)							

(*Table No. 3 Contd.*)

	Veraval	Bombay New Ferry Wharf	Karwar	Malpe	Mangalore	Calicut	Cochin Fisheries Harbour	Sakthikulangara
S. crassicornis	M 48- 83 (63) F 43-108 (83)	M 48- 93 (68) F 43-123 (93)						
P. indicus								A 101-180 M(133-138) F 143
P. semisulcatus	M 128-173 (153) F 133-193 (163-173)							
P. penicillatus	M 98-178 (143-153) F 98-228 (173-183)							
P. monodon								

SPECIES	Munambam	Ponnani	Tuticorin	Mandapam	Cuddalore	Madras	Kakinada	Waltair	Paradeep
M. affinis									M 73-138 (123) F 68-178 (128)
M. monoceros		A 66-180 M (103-125) F (98-133)						M 73-158 (123) F 68-193 (133)	
M. dobsoni	A 51-105 M (73-83) F (63-83)	A 51-110 M (68-73) F (73-83)			M 61- 85 F 61-110	M 51-110 (78) F 51-125 (88)	M 47-102 (78) F 37-112 (73)		M 58- 98 (83) F 53-113 (93)

(Table No. 3 Contd.)

M. brevicornis							
M. ensis							M 88-148 (118) F 88-173 (138)
P. stylifera	A 56-115 M (73-78) F (78-88)	A 56-135 M (68-88) F (83-93)					M 48-98 (83) F 58-118 (93)
P. hardwickii							M 48- 73 (58) F 58-118 (98)
S. crassicornis							M 48- 78 (68) F 48-113 (88)
P. indicus		A 86-190 M (118-148) F (128-158)	M 96-205 (143) F 96-215 (163)	M 108-178 (153) F 108-223 (148)	M 111-160 F 111-170	M 98-188 (158) F 108-223 (183)	
P. semisulcatus			M 81-195 (133) F 101-210 (153)	M 81-200 (123) F 71-285 (143)	M 126-160 F 126-185	M 88-198 (168) F 108-223 (198)	
P. penicillatus							
P. monodon							M 133-238 (183) F 143-313 (253)

Experimental shrimp trawling was conducted almost throughout the year at Cochin and during September, November, December and March at Madras.

At Cochin, a total of 122 hauls were taken from the different bathymetric stations fixed for the survey upto 70 m depth using RV Skipjack. Prawns were recorded upto 60 m depth, with maximum abundance (30 kg/hr) at 20 m depth in May. The bulk of the catch was constituted by *P. stylifera*, followed by *M. dobsoni*, *M. monoceros* and *P. indicus*. The highest density of *P. stylifera* was observed in the coastal waters upto 20 m depth during the premonsoon and postmonsoon periods. During the monsoon period, June-August, the entire population of this species was found to occupy the deeper areas between 20 m and 60 m depth. The mean sizes of the species during this period were 70.4 mm, 69.5 mm and 77.5 mm for males and 65.6 mm, 73.3 mm and 82.8 mm for females at 31-40 m, 41-50 m and 51-60 m depths respectively. *M. dobsoni* was recorded in sizeable quantities only during the last quarter, with maximum concentration in shallow waters upto 10 m depth. *M. monoceros* was better represented during February-March at 21-40 m depth.

At Madras, the prawn catch was maximum in September in the coastal waters within 10 m depth and was constituted by the smaller shrimps *P. maxillipedo* and *Acetes* sp. During the subsequent months, relatively better catches were recorded upto 20 m depth with *M. dobsoni* as the dominant species followed by *P. indicus*, *P. semisulcatus* and *M. monoceros*.

Assessment of lobster resources (CF/RE/1.3.1)

P. V. KAGWADE, R. FOTEDAR, K. S. SCARIAH, M. RAJAMANI and E. V. RADHAKRISHNAN

At Veraval, the lobster landings increased from 184 t to 202 t this year, keeping the catch rate more or less constant with that of the previous year. The fishery however, declined at all the other centres of observation. Bombay, the major lobster producing centre in the country, recorded 650 t at an average catch rate of 13.89 kg/unit as against 695 t at the rate of 15.86 kg/unit of the previous year. The landings of the east coast centres amounted to 10.2 t at Tuticorin and 11.6 t at Madras. The gear employed were trawl nets at Veraval and Bombay, trawl nets, gill nets and trammel nets at Madras and gill nets at Tuticorin. The fishery was good during October-February at Veraval, October-December at Bombay, November-February at Tuticorin and July and February at Madras. *P. polyphagus* and *Thenus orientalis* constituted the fishery at Veraval (34 and 66%) Bombay (53 and 47%) and Madras (nil and 100%) in the trawl nets. *P. homarus*, *P. ornatus* and *P. versicolor* contributed to the indigenous fishery at Madras and Tuticorin. The percentage of ovigerous females in the population ranged from 26 - 27 for *P. polyphagus* and 23 - 29 for *T. orientalis* along the north west coast. At Madras, the trammel nets captured large numbers of juvenile lobsters, as in the previous year, which is harmful to the fishery.

Assessment of crab resources (CF/RE/1.3.2)

K. K. Sukumaran, V. S. Kakati, N. S. Kurup, Mary K. Manisseri, V. Thangaraj Subramanian and S. Lalitha devi

The crab fishery was fairly good at Mangalore, Malpe, Madras and Kakinada, whereas, it was very poor at Cochin. The fishery at Calicut and Karwar was moderate. The crab landings by shrimp trawlers were 443 t at Mangalore (1.6 kg/hr), 294 t at Malpe (1.5 kg/hr), 5 t at Calicut (2.7 kg/hr), 128t at Madras (2.6 kg/boat) and 531 t at Kakinada (2.4 kg/hr). The indigenous gears landed 4 t (4.2 kg/unit) at Calicut and 10 t at B.V. Palem (Kakinada). The estuarine fishery by hooks and lines landed 6 t (14.9 kg/unit) at Calicut. The fishery was mainly supported by *Portunus sanguinolentus, Portunus pelagicus* and *Charybdis cruciata* at most of the centres. *P. sanguinolentus* was mainly represented by 68-158 mm size group at Mangalore and Malpe, 23-68 mm size group at Madras and 23-93 mm size group at Calicut. The dominant size group of *P. pelagicus* was 73-158 mm at Mangalore and Malpe. In *P. sanguinolentus*, females outnumbered the males at all centres. Peak spawning of the species was noticed in February at Mangalore and Malpe, April-May and January-February at Madras while at Kakinada it was December-January.

Assessment of stomatopod resources (CF/RE/1.7)

G. Sudhakara Rao, K. Y. Thelang, N. S. Kurup and K. K. Sukumaran

Good stomatopod fishery existed only along the Karnataka coast and was supported by a single species, *Oratosquilla nepa*. All the three observation centres along the coast recorded higher landings compared to the catches of the previous year. The estimated landings by trawlers amounted to 1090 t at Karwar, 5114 t at Mangalore and 4800 t at Malpe, with maximum production during December-January. An increase in the catch/effort was observed at Karwar and Malpe. Larger size groups (68-108 mm) formed the mainstay of the fishery during November to February. The spawning population dominated the catch during April-May along this coast. At Calicut, the total catch (19.5 t) and (1.4 kg) catch/hour declined when compared to the previous year. Active recruitment of the juveniles of *O. nepa* was in November. The stomatopod fishery of the east coast was multi-species in character. At Visakhapatnam, the small trawlers landed 63 t with peak catches during January. The catches as well as c/h remained more or less the same as in the previous year. *Harpiosquilla harpax* (45%), *O. interrup*ta (19%) and *O. woodmasoni* (19%) formed the main constituents of the fishery.

Investigations on the decapod crustacean resources of the outer EEZ (CF/RE/1.8)

N. N. Pillai, M. S. Muthu, C. Suseelan, K. N. Rajan, V. S. Kakati and M. Kathirvel

Zoea of the brachyuran crabs from the Bongo net collections of the first ten cruises were sorted out and studied in detail. Zoea belonging to

eleven families namely Raninidae, Majidae, Xanthidae, Pilumnidae, Calappidae, Portunidae, Dorippidae, Grapsidae, Ocypodidae, Pinnotheridae and Leycosidae were identified in the collections.

Phyllosoma larvae collected by the Issac-Kidd midwater trawl during the 10th and 14th cruises of FORV Sagar Sampada were studied. Seventeen larvae of palinurid lobsters belonging to 2 genera and 5 species were identified from the collections of 10th cruise. Larvae belonging to *Panulirus homarus* dominated the phyllosoma collections; one specimen each of *P. longipes, P. penicillatus, P. versicolor* and *Puerulus sewelli* were also present. Six specimens of palinurid lobsters were caught in the 14th cruise. Phyllosoma larvae belonging to *Palinustus mossambicus, Palinurellus wieneckii and P. homarus* were identified. Ninety seven phyllosoma larvae of scyllarid lobsters were studied from the collections of the 10th cruise. Ninety four larvae belonged to *Scyllarus martensii*, 2 larvae to *Scyllarus batei* and one to *T. orientalis.*

Prawn samples from the bottom and pelagic trawl collections of 6 cruises (1, 5, 12, 20, 23 and 27th cruises) were analysed *Parapandalus spinipes* (93-103 mm) and *Trachypenaeus curvirostris* dominated the bottom trawl catches of 17th cruise. Other species represented were *Heterocarpus woodmasoni, Plesionika martia, Metapenaeopsis andamanensis, Penaeopsis rectacuta, Solenocera chopra* and *Penaeus canaliculatus.* One sample of pelagic trawl taken at 150 m depth off Mangalore was dominated by the mesopelagic penaeid shrimp *Funchalia* spp of size 70-94 mm total length.

Field culture of marine prawns (CF/Cul/1.1.1)

M. KATHIRVEL, K. DEVARAJAN, P. E. SAMPSON MANICKAM, S. SHANMUGHAM, A. R. THIRUNAVUKKARASU and R. MARICHAMY

Madras: For the first time in India juveniles of *P. latisulcatus* and *P. canaliculatus* collected from the Kovalam backwaters near Madras were cultivated in the ponds at Muttukad. These prawns, fed with clam meat, grew from an initial size of 42 mm to 116 mm in a period of 73 days in the case of *P. latisulcatus* and from 45 mm to 119 mm in 90 days in the case of *P. canaliculatus.* The most interesting feature of this rearing experiment was the natural ovarian development in some females of *P. latisulcatus* after 73 days of culture. These females were later subjected to unilateral eyestalk ablation, induced to mature and spawn in the laboratory to produce larvae which were successfully reared to the juvenile stagae and stocked in the pond at Muttukad, thus completing the life cycle in the farm itself.

Mandapam Camp: Very high salinities prevailed in Pillaimadom lagoon during the first two quarters and hence the pen culture experiments using the juveniles of *P. indicus* collected from the wild were started during the 3rd quarter. Four pens, each 100 sq. m. in area, were stocked with 400-500 juveniles of 30 mm total length. They grew rapidly and attained a size of 108 mm in 42 days. Subsequently the pens got damaged leading to the escape of prawns.

Tuticorin: Record production rates of 1200-1600 kg/ha were obtained by growing *P. indicus* in pump-fed ponds constructed with CMFRI technical help, by a salt pan owner at Vepalodai near Tuticorin, in 5-7 months culture period. The survival rates were very high (80-95%). The salinity in the ponds ranged from 38-48 ppt, thus confirming that *P. indicus* can grow well even in hypersaline ponds. These production rates are the highest so far obtained for *P. indicus* in India.

Narakkal: Out of 10 experiments conducted in the ponds only in two short term experiments of 60-70 days duration 200-285 kg/ha of *P. indicus* could be harvested. The other experiments were affected by the "soft prawn" disease during the summer months and monsoon especially in shallow ponds infested with tilapia.

Hatchery production of marine prawn seed (CF/Cul/1.1.2)

M. S. Muthu, N. N. Pillai, A. Laxminarayana S. K. Pandian, A. R.Thirunavukkarasu, Syed Ahamed Ali, K. Devarajan, M. Kathirvel and S. Shanmugham

Narakkal: Out of the 175 *P. indicus* females unilaterally eye ablated, 121 matured and spawned in captivity. Experiments revealed that old seawater in which prawns had been grown for about a month was inferior to fresh seawater for inducing maturation in eyestalk ablated *P. indicus*. In old seawater a lesser percentage of eye ablated females matured and spawned. They took a longer time to mature, produced lesser number of eggs and showed lower hatching rate when compared to females kept in fresh seawater.

In 79 rearing experiments 3.1 million postlarvae of *P. indicus* were produced. A total number of 0.5 million hatchery reared seed of *P. indicus* was distributed to the local farmers. In 12 nursery rearing experiments PL 1 were reared to PL 10. PL 15 and PL 25 stages; the survival rates ranged from 12.8 - 50%. In 15 nursery rearing experiments PL 5 were reared to PL 10, PL 15, PL 20 and PL 25 stages with survival rates ranging from 46.5% to 61.1%. A new feed was prepared by blending 5 parts prawn meat with 1 part hen's egg and steaming the mixture to form a custard. This was broken down to a granular form by passing through a 400 micron sieve. The feed proved suitable for rearing the mysis and postlarval stages.

During the monsoon season, a broodstock of *Macrobrachium rosenbergii* was kept in the laboratory. Seven spawnings were obtained out of which 2 broods could be raised upto the 10th zoea stage on a diet of mullet eggs. The other broods were, fed on a variety of diets which proved ineffective.

During the year the project provided technical assistance to the maritime states of Kerala, Karnataka and Andhra Pradesh for starting prawn hatcheries. At the invitation of the State Fisheries Departments, the scientists surveyed the coastal areas and selected suitable sites for establishing prawn hatcheries at Mopla Bay in

Kerala, at Kumta Bay in Karnataka and at M.G. Peta in Andhra Pradesh. The project reports for the Mopla Bay and Kumta Bay hatcheries were finalised. A trial hatchery run conducted at the Mopla Bay site proved to be very successful.

Madras: At the Kovalam field laboratory *P. latisulcatus* was induced to mature and spawn in captivity for the first time by unilateral eye stalk ablation. Four successful spawnings were obtained and the larvae reared upto the juvenile stage by employing the hatchery technology evolved at Narakkal. Yet another "first" was the successful breeding and complete study of the larval development of *P. uncta* at the Kovalam laboratory. In addition to these two major achievements 1.5 lakh postlarvae of *P. indicus* and 0.8 lakh postlarvae of *P. monodon* were also produced at this laboratory. This clearly proved that the hatchery techniques developed at Narakkal are valid for a wide range of penaeid species.

Tuticorin: At the Karapad field laboratory 1.8 lakh postlarvae of *P. semisulcatus* were produced during the year using the same "Narakkal technique".

Culture of commercially important crabs (CF/Cul/1.1.3)

R. MARICHAMY

For the first time the seed of *P. pelagicus*, was collected from the wild and stocked along with the seed of *Scylla serrata*. It was found that the latter grew faster than the former during the first month after stocking. The larval rearing experiments suffered due to lack of live food organisms.

Artificial insemination and fertilization in penaeid prawns (CF/Cul/1.1.5)

M. S. MUTHU and A. LAXMINARAYANA

At Narakkal, 16 *P. indicus* spawned viable eggs after artificial insemination. The technique was used to produce larvae when natural mating was not taking place in the ponds due to low salinity. The experiments conducted during the year conclusively proved that pricking the spermatophores with a fine needle before implanting them in the thelycum of the female increased the fertilization rate to 95%.

Sea ranching of marine prawns (CF/Cul/1.1.7)

P. VEDAVYASA RAO, P. E. SAMPSON MANICKAM, MAHESWARUDU, N. N. PILLAI, A. R. THIRUNAVUKKARASU, S. SHANMUGHAM, M. KATHIRVEL and K. DEVARAJAN

Construction of a hatchery shed for rearing *P. semisulcatus* at Mandapam Camp was completed during the year for the sea ranching programme. Baseline information on the fishery for *P. semisulcatus* was collected. During the year 355 t from the Palk Bay side and 244 t from the Gulf of Mannar side were landed.

Culture of spiny lobsters (*Panulirus* spp) (CF/Cul/1.5)

E. V. RADHAKRISHNAN and M. VIJAYAKUMARAN

Histomorphology of the neurosecretory cells in the eyestalk, brain and thoracic ganglia were studied. 5 types of cells in optic ganglia and 4 types of cells in the brain and thoracic ganglia were identified.

Bilateral eyestalk ablation led to a sharp decline in free sugars and reducing sugars in the haemolymph after 24 hrs, indicating the presence of a hyperglycemic factor in the eyestalk. Eye-ablated lobsters imbibed more water than the normal lobsters during the premoult and fresh moult stages suggesting the occurrence of a water balance hormone in the eyestalk. Only during the peak breeding season unilateral eyestalk ablation led to ovarian growth, at other times it accelerated somatic growth. Changes of the setae during the moult cycle of lobster were studied as a pre-requisite for assay of moult inhibiting hormones.

Artemia biomass production (CF/Cul/1.6)

S. KULASEKHARAPANDIAN and L. KRISHNAN

Production of artemia biomass using rice bran, squilla powder and prawn head powder was tried. All the artificial feeds needed intense water management to prevent water spoilage. Production of artemia biomass with algal blooms induced by fertilizing the water with groundnut oil cake and keeping the rearing tank in sunlight proved successful. About 1 kg of biomass per t of seawater was produced in 18 days by this method.

MOLLUSCAN FISHERIES DIVISION

Survey and stock assessment of cephalopod resources in the Exclusive Economic Zone (MOL/RE/1.2.3)

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The collections of oceanic and neretic cephalopods by FORV *Sagar Sampada* were examined. Notable collections in pelagic trawl were made in cruise No. 22 in October 1986, in the area between 18°-22°N and 64°-69°E (off Bombay-Okha region). While the depth ranged from 247.5-3437 m, the depth of operation of the net was from 40-250m. About 700 specimens of oceanic squid *Symplectoteuthis oualaniensis*, measuring 6.5-47.2 cm DML, the largest weighing 3.5 kg, were caught with several species of forage mesopelagic fishes.

For stock assessment of cephalopods in inshore waters, the fishery was monitored at various centres. A special survey was made to Lakshadweep to investigate the octopus fishery.

Veraval: The cephalopod production during April '86-March '87 was estimated at 3690 t with a CPUE of 67.7 kg/U. The catch-rate was highest in October (141.1 kg/U) and the lowest in June (1.4 kg/U). *Loligo duvaucelii* (30-240 mm) contributed 2068 t and *Sepia elliptica* (20-145 mm) 1623 t.

Bombay — New Ferry wharf: 6227 t of cuttlefishes and squids were landed. (April '86-March '87). The catch rate was 218.2 kg/U. It was highest during December (584.1 kg). The landings increased by about 121% during the first half year but declined by about 6% during the second half year. Cephalopods formed about 10% of the landings during the year and 31% during December. *L. duvaucelii* (24-319 mm) formed about 46% followed by *S. pharaonis* and *S. aculeata* (34-249 mm) in almost equal percentages.

Bombay — Sassoon Docks: The estimated landings from April 1986 to January 1987 were 4336 t, forming about 9% of total landings by the vessels with a CPUE of 279 kg. The highest monthly catch of 1896 t was in December with a CPUE of 1016 kg. The lowest catch of 25 t with a CPUE of 15 kg was in August. The cephalopod fishery was constituted by *L. duvaucelii* (36%), *S. aculeata* (26%) and *S. pharaonis* (38%). *S. pharaonis* dominated during November-January. The DML range was 45-135 mm for *S. aculeata*, 169-334 mm for *S. pharaonis* and 50-220 mm for *L. duvaucelii*.

Mangalore: Landings by trawlers (738 t) declined by about 31% against a 11% decrease in effort. The catch rate declined from 25 kg/U to 20 kg/U. 92% of the catch was composed of *L. duvaucelii* and the rest by *S. aculeata* (5%) and *S. pharaonis* (3%). Monitoring of the fishery was initiated at Malpe Fisheries Harbour during the year from September. An estimated 24662 trawlers landed 226 t of squids and cuttlefishes at the rate of 9.2 kg/U. Cephalopods formed about 2% of the landings. *L. duvaucelii* (88%) was the dominant species followed by *S. aculeata* (8%) and *S. pharaonis* (4%). The size ranges of *L. duvaucelii* at Mangalore and Malpe were 40 - 289 mm and 40 - 269 mm respectively.

Calicut: An estimated 164 t of cephalopods were caught during December '86 - February '87 period at the rate of 16.1 kg/Unit. Maximum catch (119 t) and catch rate (32 kg/U) were in December. Squids *L. duvaucelii* accounted for 51% followed by cuttlefishes *S. pharaonis* (39%), *S. aculeata* (33%) and *Sepiella inermis* (28%) together accounting for 49%.

Cochin: 1021 t were landed by shrimp trawlers (21.9 kg/U). Maximum yield per unit was in November (101 kg). During July-August the catch was mostly composed of cuttlefishes. When compared with the corresponding period of 1985-86, it shows a record increase of 383%. *S. pharaonis* (44%), *S. aculeata* (33%), *S. elliptica* (22%) and S. inermis (1%) accounted for 58% of the catch and the rest by *L. duvaucelii*. During September about 1.6 t of squids were caught by drift gill nets and about 0.3 t squids by purse-seiners. Cephalopods constituted about 6% of the landings during the year.

Vizhinjam: The landings of 1772 t was the highest recorded. Squids composed of *Loligo* sp. (85%), *L. duvaucelii* (13%) and *Doryteuthis sibogae* (2%), accounted for 95% of the catch and almost entirely (93%) taken by boat seines. Peak catch (79%) was in September constituting about 51% of the landings by the gear. The hook-and-lines yielded only 84 t of *S. pharaonis*. *L. duvaucelii* ranged from 20 to 180 mm, *Loligo* sp. 130 to 300 mm and *S. pharaonis* 100 - 300 mm.

Mandapam & Rameswaram : At Mandapam shrimp trawlers landed an estimated 188 t at the rate of 5.7 kg/U during April - December. Cephalopods formed about 6% of the landings. *S. aculeata* (65%) *S. pharaonis* (24%) and *S. inermis* (11%) accounted for 91% of the landings while *L. duvaucelii* formed 8%. About 1 t of *Euprymna* sp was caught during November. The size range of *S. aculeata* was 20 - 179 mm.

At Rameswaram 366 t of cephalopods i. e., cuttlefishes (93%), squids (6%) and *Octopus* sp. (1%) were caught (5.1 kg/U). Their contribution to the all fish catch was 3%. Among the cuttlefishes *S. aculeata* formed 89%, *S. pharaonis* 8% and *S. inermis* 3%. The size of *S. aculeata* ranged between 20 and 189 mm. Octopuses were caught during the third quarter. Better landings were recorded during May and December.

Madras: About 131 t were landed during April-December (4.1 kg/U). Cuttlefishes accounted for 85%. The squid

catches were unusually low. *S. pharaonis* was dominant among the cuttlefishes, while *L. duvaucelii* formed the bulk of squid landings. *Doryteuthis sibogae* was caught during April-June.

Kakinada: Total estimated landings during April 86 - February 87 were 409 t, about 1.2% of trawler landings. The species were *L. duvaucelii* (28%); *S. aculeata* (27%); *S. pharaonis* (22%) and *S. inermis* (23%). The CPUE during October-February was 16.7 kg as compared to 6.2 kg during April-September. *S. pharaonis* landings (110-290 mm) were good during the year, particularly in December. The DML ranges were 30-280 mm for *L. duvaucelii* (dominant 95 mm) and 40-220 mm for *S. aculeata* (dominant 65 and 125 mm).

Visakhapatnam: 233 t were landed with a marginal increase of 8%, forming 3.2% of all fish landings. Squids formed 41% and the cuttlefish 59%. Among cuttlefish *S. pharaonis* contributed 53% and *S. aculeata* (30%). The DML ranges of *L. duvaucelii, S. pharaonis* and *S. aculeata* were 51-298 mm, 66-280 mm and 48-190 mm respectively.

Population studies on clam resources (MOL/RE/1.8)

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Kakinada: During May-February, a total of 125.5 t of *Anadara granosa* were landed at Yetimoga (41.3 kg/man day). The length ranged from 17 to 71 mm and the age groups 1-3 contributed to the bulk. The species density in the Kakinada Bay varied from 2.8 to 17.9 nos/m^2 during October-February. The temperature varied from 24 to 34°C, salinity from 14.8‰ to 32.19‰ and D.O. from 2.73 to 4.86 ml/l.

Cochin: Observations on *Villorita cyprinoides* at 3 centres in Vembenad lake during December-March indicated that catch per man day was 60-136 kg. The length ranged from 9 to 34 mm. The standing stock varied from 64-125 nos./m^2.

Karwar: In Kalinadi, the catch per man day for *Meretrix meretrix* (21-48 mm) varied from 1.65 kg to 2.5 kg and for *V. cyprinoides* (15-44 mm) from 2 to 5 kg during April - September. Young ones of *V. cyprinoides* occurred throughout the period while those of *M. meretrix* only during August-September. *M. meretrix* spawned during the early monsoon period.

Culture of edible oyster (MOL/CUL/1.1)

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Tuticorin: During April-May, 600 strings of oyster shells and four racks of lime coated tiles were used for spot collection. In Korampallam creek, 200 rens and 4000 tiles were laid. From the tiles, 1700 spat were collected for rearing. 500 kg of oyster meat was sold to IFP while 62 kg of oyster meat and 920 oysters were sold locally. *C.*

madrasensis males were dominant except in October. Females, spawned during April-December. Mature males occurred in May-July, October and December.

Four species of oysters namely *C. madrasensis, C. gryphoides, C. echinata* and *Saccostrea cucullata* were obtained from Bombay, Sikka (Gujarat) and Kakinada. *Ceratium* sp. along with diatoms and *Oscillatoria* sp. were observed in the plankton collected from the oyster culture site in Tuticorin Bay during April, June and October.

Kakinada: *C. madrasensis,* females outnumbered males in all months except January. Spawning was during April-June and October-February. The condition index was high during April-July, low in August, October and January and moderate in other months. The temperatures varied from 23.3 to 32.3°C, salinity from 2.03‰ to 30.27‰ and D.O. from 1.80 ml/l to 3.18 ml/l.

Madras: Oysters in Kovelong backwaters, Ennore estuary and Pulicat lake were identified as *C. madrasensis* and *Saccostrea cucullata.* Spat settlement in *C. madrasensis* took place in September on lime coated tiles, asbestos sheets and Mangalore tiles.

Bombay: At Bandra, *Saccostrea cucullata* (9-50 mm) were found on granite rocks and the standing stock was 44.8 t. The small size has been attributed to the discharge of industrial effluents and domestic sewage.

Karwar: Size, weight, sex ratio, stages of maturity, condition factor and environmental conditions of *S. cucullata* of Kalinadi were studied. Sexually ripe oysters were recorded in May '86, December '86 and January '87.

Culture of green mussel in saltwater lagoons (MOL/CUL/1.2.1)

P. V. SREENIVASAN, K. RAMADOSS

At *Madras,* pole and bag culture were adopted for culture of *Perna viridis.* 75 poles were seeded at a rate of 4 kg seed/pole, packed in 2 m. cotton bag. 39 nylon bags (15 mm mesh) were seeded with 3.2 kg seed/bag. This was done in August.

In 7 months, the length increase of mussels on poles was 8.1 mm/month while weight increase was 6.71 g/month. The increase was 8.8 mm/month and 7.11 g/month with bag culture. At harvest in February (after 6 months), the average productions were 13.97 kg on poles and 18.03 kg from the bags.

Mature, spent and spent regressive specimens were seen in the cultured mussel populations. Males were dominant among the mussels on poles, while females dominated among mussel in bags. At Ennore piers, intensive spat settlement was recorded during October-November. Settlement was also noted on the dredger pantoons in the Ennore estuary.

Development of hatchery system for mussel seed production (MOL/CUL/1.6)

K. K. APPUKUTTAN, P. V. SREENIVASAN

Vizhinjam: Experiments were done on conditioning, induced spawing, larval rearing and spat settlement of *Perna indica.* The spat were transferred to the farm for growth studies.

Madras: Conditioning, induced spawning and larval rearing of *P. viridis* were conducted. Larval development upto umbo stage was observed.

Mass production of edible oyster seed in hatchery system (MOL/CUL/1.5.1)

K. NAGAPPAN NAYAR, K. SATYANARAYANA RAO, P. MUTHIAH, M. E. RAJAPANDIAN

18 batches of *C. madrasensis*, obtained from Tuticorin bay, Tuticorin harbour and Pinnakayal estuary, were conditioned for maturation at a temperature of 5°C below normal, on a diet of mixed phytoplankton. The oysters matured within 14-23 days. Oysters fed with mixed phytoplankton and boiled corn meal flour were found to be conditioned well for maturation.

Spawning was induced by transferring oysters to sea water kept at 32°C. 5 M hydrogen peroxide also induced spawning. 14 batches of oysters were spawned but seed obtained only from 8. Larval rearing was done almost throughout the year. Larval density was 3 nos/ml in the presetting phase and 500 litre in the setting phase. The spat setting period ranged from 15 to 22 days and high spat production was observed when the salinity was 20 - 25‰.

Investigation on ecophysiological factors influencing developmental biology of clams (MOL/CUL/1.3.2.)

G. P. KUMARASWAMY ACHARY

V. cyprinoides, Katelysia opima, P. malabarica, M. casta, Sanguinolaria sp. and *Mactra* sp. were studied. Stratification was observed and the maturity stages were not reaching the spawning condition. Higher settlement of *P. malabarica* was noticed at Neendakara where the salinity was 28.5‰ and oxygen 2.4 ml/l and was not affected by coconut retting in the nearby area. The clams were in advanced maturity condition during the latter half of the reporting period. The higher percentage of settlement of *P. malabarica* during June was due to the spawning before April. The work on euryhaline live feed was also continued and it was observed that after a short period the viability of culture medium decreased. Further standardization is in progress.

Callista grycynia, a new clam from Vizhinjam was reported to have good culture and export potential. Ecological factors influencing development and establishment of the clams were studied.

Pearl culture (MOL/CUL/1.4)

K. ALAGARSWAMI, A. CHELLAM, A. C. C. VICTOR, S. DHARMARAJ, T. S. VELAYUDHAN

The shoreward paars which sustained some pearl oysters consistently during the last 10 years had gone into the recessive phase in 1986. The oyster collections have been none or a few.

During December 1985-December 1986, *Pinctada fucata,* grown in the harbour farm at Tuticorin, showed a growth rate of 3.6 mm/month in size

and 1.87 gms/month in weight while those in the commercial farm at Krusadai island showed 3 mm/month and 1.19 gms/month. In a second batch this rate was found to be 2.6 mm/month and 2.25 gms/month at Tuticorin and 1.1 mm/month and 0.42 gms/month at Krusadai. *P. fucata* spat supplied to Lakshadweep were reared in Bangaram and Agathi. Spat supplied in October (13.2 mm) grew to 29.1 mm in Bangaram and 22.9 mm in Agathi by mid-February.

Spawning of pearl oyster was observed in Tuticorin during May-July (major) and October-November (minor).

Single implantation was done in 702 oysters and double implantation in 118 oysters. Pearl production rate (gross) from 1985-operated oysters was 29% in one batch and 31.5% in another.

Experimental pearl oyster hatchery for mass production of spat (MOL/CUL/1.7.1)

K. ALAGARSWAMI, S. DHARMARAJ, A. CHELLAM, T. S. VELAYUDHAN

An estimated 0.75 million larvae of *Pinctada margaritifera* were produced and reared during January-February 1987. A total of about 48800 spat set in the tanks were reared in the laboratory. In another experiment larvae of *Pteria* sp. were produced and reared in the laboratory.

Four rearings of *Pinctada fucata* larvae yielded 2.4 million spat at settling stage. In the experimental work it was seen that (i) the percentage of spat settlement among the culled larvae was greater than among the unculled larvae (ii) larval rearing under aeration resulted in 9.9% of spat production as compared to 40.6% under non-aerated conditions and (iii) larval densities at 2, 3, 4 and 5 larvae/ml gave settlement rates of 31.6, 19.1, 14 and 13.5 per cent in one experiment and 12.8, 10.3, 17.7 and 3.4 per cent in another.

33-34% of pearl oysters fed with mixed algae and corn flour reached maturity against 26% of oysters fed with mixed algae alone. Under 25°C for 20 days, mature oysters showed regression of gonadal stage.

P. fucata spat of 5-20 mm size in polythene bags, survived with less than 4% mortality, under oxygen filling, for 102 hours. A total of 10,000 spat given to the Department of Fisheries, Lakshadweep in October 1986 could be transported without any mortality from Tuticorin to Bangaram and Agatti. A training course in Pearl Oyster Hatchery Technology was conducted for the State Department personnel from 27 October - 22 November 1986.

Investigations on the mussel spat settlement and seed slipping on transplantation (MOL/CUL/1.2.2)

K. K. APPUKUTTAN, P. S. KURIAKOSE

Experiments at Vizhinjam indicated primary settlement of *Perna indica* mostly on smooth surfaces like seaweeds, polyethylene monofilaments and walls of the rearing tanks but secondary attachment on hard substrata

like roof tiles and granite blocks. Natural beds showed heavy spat settlement intially on brown algae and gradual shifting to rocks when 4-8 mm size. Experiments on byssogenesis showed that mussels (20-30 mm) secreted maximum number of threads within 18 hours. Seed slipping from HDP ropes with seed length of 20-30 mm was insignificant. Seed from submerged ropes showed maximum settlement.

There was good settlement of *P. viridis* in Calicut area during July to September. Primary and secondary settlement from the wild was observed. The rate of settlement on intertidal and submerged rocks was studied. Seeding was initiated.

Breeding and experimental sea-ranching of commercially important gastropods (MOL/CUL/1.10)

S. Mahadevan, K. Ramadoss, K. Prabhakaran Nair

At Mandapam, the gonadal condition of *Turbo* sp. was favourable for breeding experiments. The egg diameter was about 165 μ. Chemical and thermal inducements were not successful. In the second and third quarter, the egg diameter of *Trochus* sp. was 170 μ and for *Turbo* sp. it was 190 μ During November the egg diameter of *Trochus* sp. was found to be 150 μ. During December, the egg diameter was 165 μ. The inducement was successful only by photonegative experiments. The larvae survived only for 8 hours.

Investigations on "Biocoenosis" to improve culture ecosystem (MOL/CUL/2)

G. P. Kumaraswamy Achary, C. S. Gopinadha Pillai, P. A. Thomas, S. Lazarus, Rani Mary Jacob

The early developmental stages of *Murex trapa* were collected. 13.23 kg of egg mass in one haul from off Poonthura was brought to the laboratory and studied. The animals were spawned and larval behaviour studied. Algal gametes were observed in the plankton and their utility as feed for bivalve larvae studied. Investigations were made to study the peak settlement of algae, on the release of gametes by *Ulva* sp., *Chaetomorpha* sp., *Cladophora* sp. and also on the behavour of algae in primary film formation. A—sexual reproduction in the sponge *Clathrena coreacea* was studied. The impact of micropolychaete predators in hatcheries was studied. 26 species of major algae were identified. The algal microsystem was worked out in detail by conducting experiments to compare with the natural system. Different microenvironments were simulated in the culture ecosystem by launching experimental gadgets in the sea and the effect of species interaction in the system is being studied.

Studies on biology, population and migration of the sacred chank *Turbinella pyrum* (MOL/RE/1.10)

S. Mahadevan, K. Ramadoss, P. Natarajan D. Sivalingam, K. K. Appukuttan

The catch statistics of chanks along Ramanathapuram and Tirunel-

veli coast was collected. Since there was a gap in the statistics from 1978 to 1986, priority was given to collect the figures from the records of the State Govt. Fisheries Department. It was seen that the years 1981-82 to 1983-84 were the most productive from the point of view of total landings in Ramanathapuram coast, landing 227118, 296735, 467655 and 440056 shells. Similarly Tuticorin fishery also recorded good landings ranging from 700000 to 1000000. The current years' statistics will be finalised after the season comes to a close.

At Tuticorin 50 chanks (55-70 mm) were marked and released. A few egg capsules of chank brought by the fishermen were kept alive to observe development of fertilized eggs. 134 baby chanks were released after 45 days in one capsule.

Resource and ecological monitoring of pearl oyster beds and their repopulation (MOL/RE/1.11)

A. C. C. Victor, A. Chellam, S. Dharmaraj

Twenty five pearl banks off Tuticorin were inspected. The shoreward paars were almost barren compared to the previous years when on an average 1000 oysters could be collected on each day of two hour diving. Stray oysters (25-45 mm) were picked up. The rocky beds south of Tuticorin also showed a similar condition. An intensive survey of Tiruchendur beds during March '87 showed this area also to be devoid of oyster populations.

Culture of cephalopods (MOL/CUL/1.8)

D. Sivalingam

At Mandapam eggs of *Sepia pharaonis* and *S. lessioniana* were collected from the spawning grounds and reared in the laboratory tanks to the adult size (175 mm). Observations were made on the progression of developmental stages till the adult size (175 mm).

DEMERSAL FISHERIES DIVISION

Resource characteristics of perches (FB/DR/1.8.2)

P. SAM BENNET, P. LIVINGSTON, K. ALAGARAJA, S. K. CHAKRABORTY and S. LAZARUS

Salient features: Studies were carried out at Tuticorin, Mandapam, Bombay and Vizhinjam. Good perch landings were reported by trawl at Bombay and by indigenous gear at Tuticorin. The fishery was moderate at other centres.

Work done: Commercial trawling landed good quantities of perches at Bombay Sassoon Docks and at New Ferry Wharf, *Lutjanus malabaricus* in good numbers, followed by *L. johnii, L. argentimaculatus, Epinephelus diacanthus, F. tauvina* and *Pomedaysis hasta*. At Vizhinjam 462 t were caught by hooks and line (62%) and by drift nets (12%) with many of the crafts using out-board engines. Serranidae, Nemipteridae, Priacanthidae and Lethrinidae formed the important groups in the Vizhinjam fishery. Peak occurrence was in June-September (63%), with a minor peak in January-February (21%). Mechanised units at Tuticorin landed 524.3 t during the year, while non-mechanised units landed 107.3 t. January was the peak season at Tuticorin and hooks and line the important gear. Many of the drift-net units migrated to other centres for better landings. Small perches were caught by drift nets and small shore-seine (Olai valai) at Tharuvaikulam near Tuticorin. *Lethrinus nebulosus* was the major species, followed by *Serranus* spp., *Lutjanus rivulatus, Epinephelus malabaricus, Lates calcarifer, Psammopera waigiensis* and *Diagramma* spp.

Lethrinus nebulosus (4.0 - 70.0 cm) were observed in the Tuticorin fishery. Larger fish (20. - 70.0 cm) were caught in the hooks and lines. Drift net (Paruvalai) catch was composed of fish 30 - 60 cm in length. Smaller fish (7.0 - 43.0 cm) were caught by small-meshed drift nets (podi valai). Olai valai (small shore seine) catch composed of fish from 4.0 - 24.0 cm.

Assessment of sciaenid resources (FB/DR/1.8.4)

T. APPA RAO, V. SRIRAMACHANDRA MURTY, P. DEVADOSS, E. VIVEKANANDAN, K. V. SOMASEKHARAN NAIR, K. VIJAYALAKSHMI, S. K. CHAKRABORTY and S. G. RAJE.

Salient features: Studies on the multi-species sciaenid fisheries were carried out at Waltair, Kakinada, Madras, Cochin, Bombay and Veraval. Biological studies were made on *Johnius carutta, J. vogleri, J. macrorhynus,* and *O. cuvieri.*

Work done: At Waltair an estimated 549 t was landed by private trawlers and they formed 8% of the total catches. The total catches increased by 14% when compared to that of the previous year. Increased catches were obtained during April-August. Maximum effort was in September '86 with a corresponding high c/u value of 45.99 kg. A second peak was observed in November, the c/u being 54.29. The minimum values were in April '86. Out of eleven species, *J. carutta* formed 46.2%, *K. axillaris* 31.5%, *J. vogleri* 6.96% and *J. dussumieri* 2.8%. 0-year and 1-year groups contributed to the catches.

At Kakinada an estimated 1320 t were obtained, which contributed to 6.4% of total trawl catches. The landings increased by 18% with increase in effort also by 4.5%, when compared to that of last year. Out of 18 species, *A. nibe* (23.9%), *J. vogleri* (12.6%), *J. dussumieri* (9.9%), *O. ruber* (9.7%), *P. macrophthalmus* (5.0%) dominated the catches. *J. carutta* ranged in size from 80-219 mm, with a minimum modal length of 115 mm. The value of total mortality was found to be 6.3 and natural mortality as 1.0, with consequent value of F = 5.3. Maximum sustainable yield was obtained when F = 5.8 and t_o = 1.8.

At Madras about 200 t were brought by private trawlers at Kasimode and comprised about 4.2% of the total landings. In October the maximum catch and catch rate were recorded. When compared to the corresponding period of the previous year, the catches increased by 32%. Out of 13 species that contributed to the fishery, *J. carutta* (25%), *O. argenteus* (19%) and *P. aneus* (12%) dominated. *J. carutta* had a length range of 80-249 mm. Fish measuring 140 - 149 mm were dominant. Females with ripe gonads were observed during April-June and September-November. *Squilla* sp. and prawns were the chief food components.

At Bombay an estimated catch of 5924 t was landed, contributing to 11% of the total catches. In October, peak landings, with the highest CPUE value of 13.5, were obtained.

J. macrorhynus, J. vogleri, and *O. cuvieri* dominated the catches. *J. macrorhynus* ranged in size from 99 - 319 mm; *J. vogleri* from 150 - 189 mm and *O. cuvieri* from 90 - 389 mm. Growth and mortality studies of the above species were carried out. For *J. macrorhynus,* the values were K = 0.5331; $L\infty$ = 395 mm; Z = 1.96; M = 0.597; for *J. vogleri* K = 0.5077; $L\infty$ = 354; Z = 2.45; M = 0.642.

At Veraval 5111 t were landed by trawl and 103 t by gill nets. The peak landings by trawl were in November, with CPUE of 13.67 kg/h, while the gillnets brought in peak catches in May with C/E of 2.09 kg/h. *S. brunneus, P. diacanthus, O. cuvieri,. J. vogleri* and *J. macrorhynus* dominated the landings.

Resource characteristics of silverbellies (FB/DR/1.8.5)

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Salient features: The catch and effort data were analysed and the bio-

logy of *L. bindus* and *S. insidiator* studied. Data from an exploratory cruise in northern Bay of Bengal were analysed.

Work done: At the Visakhapatnam Fisheries Harbour, the small shrimp-trawlers landed an estimated 431 t which formed 6.4% of the total catch. Peak catches were observed in June, September and January. At Kakinada, the private trawlers landed an estimated 1,790 t which formed 8.6% of the total trawl catch. Maximum catch and catch rate were obtained in May. The catch showed an increase of about 20% over that of the previous year with about 4.5% increase in effort. At Madras, the private trawlers landed an estimated 874 t which formed about 12% of the trawl catch. Peak catches and rates were obtained in July, September and February.

8 species contributed to the fishery at Visakhapatnam, *L. bindus* formed 69.6% of the total catch, followed by *S. insidiator* (14.4%) and others. At Kakinada, 9 species contributed to the fishery. *S. insidiator, L. bindus* and *L. dussumieri* were most abundant forming over 80% of the landings. At Madras of the 12 species *S. insidiator* and *L. bindus* were most abundant.

At Waltair the length range of *L. bindus* catch was 10 - 129 mm; smaller fishes, forming a mode at 32 mm, during July-January. At Kakinada, the length range was 20-124 mm and the smallest modal length was 27 mm in August and November. At Madras, the length range was 30-129 mm and gravid females occurred in almost all months.

At Waltair the length range of *S. insidiator* was 30-119 mm and the smallest modal length was at 62 mm in May. At Kakinada the range was 30-119 mm and the smallest modal length at 47 mm in August. At Madras the range was 50-119 mm, the smallest modal length at 67 mm in April. Gravid adults occurred in the catches in almost all months.

In *L. bindus* the mortality rates were estimated as Z = 3.6, M = 1.2 and F = 2.4. The exploitation rate was 0.65 and the total annual stock 697 t and the average standing crop at 189 t. In *S. insidiator*, the mortality rates were estimated as Z = 5.0, M = 2.6, F = 2.4. The exploitation rate was estimated as 0.48 and the total annual stock as 1370 t against the estimated yield of 658 t.

The data from a cruise of R. V. *Skipjack* during February 1985 along West Bengal coast showed that *L. bindus* was the most dominant species and was caught 6-15 m above the sea bottom during night in depths ranging from 21 - 35 m. Larger fishes occurred in relatively deeper waters. The stock of *L. bindus* along West Bengal coast appeared to be a virgin stock. The estimated value of total mortality rate at 1.02 can be taken as natural mortality rate.

Meso & Bathypelagic resources of the EEZ (FB/DR/1.9.2)

M. Kumaran, V. N. Bande, N. G. Menon, S. Sivakami and A. A. Jayaprakash

Salient features : During the year under report, meso and bathypelagic

fishes collected by *Sagar Sampada* were analysed qualitatively and quantitatively, separately for both pelagic/mid water trawl and bottom trawl.

Work done: The samples of pelagic/midwater trawl from 26 stations in the depths from 941 - 3684 m obtained from cruises 12, 19, 20, 21 and 22 of *Sagar Sampada*, were analysed. The meso/bathypelagic resources comprised 25 species of fishes belonging to 14 families. The total catch per haul varied from 0.5 - 38.5 kg.

During Cruise No. 19, *Cubiceps natalensis* constituted the most important group, followed by myctophids and young tuna. *C. natalensis* was found in almost all stations. *C. natalensis* from station No. 655 ranged from 80 - 130 mm with a mode at 120 mm. At station 656, the size of *C. natalensis* ranged from 50 - 140 mm with modes at 60 and 120 mm. *Kyphosus* sp. ranging in length from 235 - 270 mm and *Gempylus serpens* ranging from 360 - 410 mm were recorded from most of the stations. Young tuna were caught from all the stations; the size ranging from 50-135 mm with a mode at 70 mm.

At station 389 from a depth of 3396 m, a variety of species of fishes such as *Stomias affinis, Astronesthus richardsoni, Echiostoma barbatum, Chauliodus pammelaus, Photichthys argenteus, Idiacathus niger* and *Malacosteus indicus* were recorded.

Several species of the family Myctophidae, such as *Diaphus elucens, Myctophum evermanni, M. spinosus, M. affinis, Symbolophorus* sp., *Lampanyctus pusillus, Bolinichthys* sp., *Triphoturus* sp., *Lobianchia* sp., and *Ceratoscopelus* sp., were available from deeper waters.

Psenes squamiceps ranging in length from 77 - 146 mm was fairly common at stations 380, 385, 392, 679, 681, 722, 727 and 745 from the depth range of 2000-3700 m. The fishes were in maturity stages II - V.

Bottom trawl samples from 10 stations were analysed. The catch consisted of 28 species of fishes belonging to 21 families. The trawling was conducted at depths ranging from 64 - 1898 m. The catch varied from 1 kg to 9 t. The maximum catch of 9 t was from a depth of 64 m and comprised mainly *Nemipterus* sp. The operation at the maximum depth of 1898 m yielded only one kg. of cephalopods. *Rhinochimaera* sp., *Trichirus auriga, Diplophos* sp., *Chlorophthalmus* sp. etc. were encountered at a depth of 1037 m.

Assessment of catfish resources (DF/RE/11)

V. N. Bande, S. G. Raje, Kuber Vidyasagar, K. Y. Telang, C. Muthiah, N. G. Menon, P. Devadoss and Y. Appanna Sastry.

Salient features: The marine catfish fishery showed a marginal decreasing trend at most centres. The *T. tenuispinis* showed a declining trend at some centres, while at others a slight revival. Wherever *T. tenuispinis* fishery declined the gap was filled by other species. This year also mass destruction of eggs and young ones of

both *T. tenuispinis* and *T. dussumieri* were reported from Malpe and *T. serratus* from Karwar. This is a matter of serious concern as it affects the stock and future recruitment.

Work done: At Veraval, a total of 757.8 t of cat fishes was landed which formed only 0.8% of the total fish catch. Both catch and catch rate had declined during the '86-'87 period. In trawl catches which made up 54% of total catch, *T. dussumieri* contributed 37.8%, followed by *T. tenuispinis* 27.7%, *T. thalassinus* 13.8% and *O. militaris* 12.4% The landings by gill net (46%) also showed a similar trend in species composition; *T. dussumieri* 46.5%, *T. tenuispinis* 19.0%, *T. thalassinus* 12.3% and *O. militaris* 5.2%. In the trawl net *T. dussumieri* was supported mainly by the sizes 180-380 mm; while in the gill net the major size group was 670 - 840 mm. *T. thalassinus,* trawl catch was dominated by size groups 350 - 510 mm and in the gill net the sizes that constituted the main fishery were 610 - 740 mm. *T. tenuispinis* catches from both trawl net and gill net was supported by fishes of 330 - 530 mm.

At Bombay New Ferry Wharf, the total catch was 1829.3 t, landed by trawlers, with a catch rate of 90.9 kg which formed 4.2% of the total fish catch. The maximum catch was recorded in September. The catch rate fluctuated between 54.1 and 137.6 kg. The common species in the landings were *O. militaris, T. thalassinus, T. sona* and *T. dussumieri.*

At Karwar the total catch was 152 t mainly by purse seines, Rampan and trawl nets. *T. serratus* and *T. thalassinus* constituted 72% of the catch and *T. tenuispinis* the rest. The latter species was the main constituent in the trawl net. The catch rate in the purse seine was 3821 kg, in the Rampan it was 3350 kg and in trawl 3.9 kg. About 6700 kg of *T. serratus* gestating males were caught by Rampan along with juveniles (8 baskets) of the size 65 - 102 mm.

The catfish fishery at Mangalore decreased by 13% when compared to that of the previous year. Out of the total 1769 t, 97% was contributed by purse seine. As high as 98% of the landing was during the September-October period. There was a substantial decrease in the purse seine effort, which may be mainly due to poor catch consequent to the appearance of noctiluca bloom, during December-January period. The catch rate by the purse seine was 172 kg showing 17% increase over last year. *T. tenuispinis* (81%) was the most dominant species, followed by *T. dussumieri* (11%). The latter species showed a drastic decline when compared with the last year (68%). Drift net catch was high during September-November (96%). *T. thalassinus* (50%) and *T. serratus* (32%) dominated the catch.

At Malpe Fisheries Harbour 2626 t were caught, 97% by purse seine with a CPUE of 262 kg. The peak catch was during September-October. It was estimated that exploitation of gestating males of *T. tenuispinis* destroyed at least 1.9 million eggs. About 3.75 lakhs of juveniles of *T. dussumieri* also got destroyed in purse-seining for the species.

At Cochin Fisheries Harbour, the total catch was 926.7 t, showing an increase of 30% over last year. The drift net caught 618.9 t and the rest was by trawl net. *T. thalassinus* was the most abundant species (41%), followed by *T. tenuispinis* (32.5%), *T. serratus* (20%) and *T. dussumieri* (6.5%). The drift net catch rate varied from 0.8 to 63.5 kg (in October) with an average of 32 kg and *T. thalassinus* (46.7%) and *T. serratus* (30%) were the important species. About 94% of the catch by trawler was during June and August having a catch rate of 44.6 kg (in June). The catch rate showed a declining trend from 107.2 kg in '85-'86 to 44.6 kg in '86-87. Though the catch of *T. tenuispinis* declined, the lacuna was filled by *T. thalassinus* and *T. serratus*.

The catch at Madras (Kasimode) centre was negligible, 3.1 t, contributed by trawl net (91%) and the rest by gill nets, with rates of 0.06 and 0.09 kg respectively.

The trawl catch at Visakhapatnam was 118.9 t (CPUE of 5.6 kg) which formed 1.8% of the total fish catch. When compared to last year this year's catch almost doubled. High catches were recorded during July and October-February. *T.thalassinus* was the most dominant species throughout the year (97.4%), and was mostly represented by the smaller size group of 120 - 500 mm.

Stock assesment of threadfin breams (DF/RE/12)

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Salient features: Besides observations on the fisheries along the east and west coast the biology of the main species *N. japonicus, N. mesoprion* and *N. delagoae* was studied.

Work done: At Waltair, the private trawlers landed 480 t which formed about 7% of the total trawl catch. Maximum catch and CPUE were obtained in April. The catch showed a decline of 32% over that of the previous year along with a 15% decline in effort. At Kakinada, the private trawlers landed an estimated 629 t which formed 3.0% of total trawl catch. Higher catches and rates were obtained during November-January period. The value of landings during the period increased by 73.4% over that of the previous year along with about 4.5% increase in effort. The private trawlers at Madras landed an estimated 856 t of nemipterids which formed 12.0% of total trawl catches and showed an increase of 8.3%, though there was a slight (0.5%) decline in the effort. The trawlers at Tuticorin landed an estimated 570 t (no landing October-December period). Maximum catch and catch rate were obtained in June.

The hooks and lines brought an estimated 10.5 t of *Nemipterus* spp. during January-February 1987. The trawlers at Cochin landed an estimated 6545 t. *N. japonicus* and *N. mesoprion* contributed to the fishery. Though the peak abundance was in the common period, as in previous years, the catches were good during almost

all the months and showed a three-fold increase over that of the previous year. At Vizhinjam the hooks and lines and boat seines together landed an estimated 247 t of nemipterids. Maximum catches were obtained by mechanised hooks and lines. At Vizhinjam four species contributed to the fishery and *N. mesoprion* was most dominant. The private trawlers at New Ferry Wharf (Bombay) landed an estimated 1487 t which formed 2.8% of the total trawl catch. Maximum catch was in October. The catch of nemipterids showed an increase of 113% over last year's, along with about 20% increase in the effort. At Veraval, the trawlers landed an estimated 3900 t which formed 10.7% of total trawl catch. There was no fishing during June-August and highest catch was in October. The catch this year showed a four-fold increase with about 50% increase in effort.

Studies on the biology of the two main species showed that, in *N. japonicus*, the length ranges were 60 - 279 mm, 40 - 299 mm and 90 - 289 mm at Waltair, Kakinada and Madras respectively. At Cochin, the range was 35-305 mm with the smallest modal length at 65 mm in November. The smaller modal lengths were at 95 mm in December and 85 mm in February at Waltair, at 85 mm in December at Kakinada and at 115 mm in April, May, August and September at Madras. At Bombay and Veraval, the length range was 95-320 mm; at Bombay, smaller fishes forming the mode at 125 mm occurred in May and February and at Veraval at 115 mm in February. Gravid adults occurred in February, May-July at Madras; in all months, except May-July and January, at Bombay and during September, October and December at Veraval.

For *N. mesoprion*, the length range was 50-209 mm at Kakinada, 100 - 199 mm at Madras, 60 - 309 mm at Bombay and 60 - 249 mm at Veraval. At Cochin, the length range of the catch was 35-265 mm with the smallest modal length at 65 mm in November. At Vizhinjam, the length range of the catch was 145-244 mm with the smallest modal length at 155 mm in July. The smallest modal length was at 75 mm in December at Kakinada; at 115 mm in April, May, August and February at Madras; at 115 mm in April and January at Bombay and at 95 mm in April at Veraval. For *N. delagoae*, the length range at Tuticorin was 110-279 mm and the smallest modal length was 145 mm in May.

The total, natural and fishing mortality rates of *N. japonicus* at Kakinada were estimated as 2.2, 1.1 and 1.1 respectively. The exploitation rate was estimated as 0.44 and the total annual stock at 459 t against the estimated yield of 202 t. For *N. mesoprion* the rates of mortality were estimated as $Z = 4.37$, $M = 1.01$ and $F = 3.36$.

Assessment of Elasmobranch resources (DF/RE/13)

M. D. K. KUTHALINGAM, P. DEVADOSS, P. LIVINGSTON, K. M. S. AMEER HAMSA, K. PRABHAKARAN NAIR, GRACE MATHEW and K. S. SUNDARAM.

Salient features: The project was initiated during the year and observations carried out at Bombay, Cochin,

Vizhinjam, Tuticorin and Madras. The total catch for the period April 1986 to February '87 was estimated as 5721 t. Bombay being the most important landing centre accounted for 76.8%.

Work done: At Madras, estimated landings of 250 t were recorded from the bottom-set gill net ('Thirukkai walai'), trawl, drift gill net and hooks and line. The contribution of rays was 68.2% from all the units. Thirukkai valai accounted for 48.6% of the elasmobranchs, followed by trawlers with 40.9%. Thirukkai valai appeared to be the most effective gill net, its annual average contribution being 322.6 kg per unit. The maximum CPUE of 669 kg was during August. Species of *Dasyatis* dominated the catches. Sizes of *Sphyrna lewini* ranged from 54-104 cm while that of *D. uarnak* from 46-150 cm. Mature *Rhynchobatus djeddensis* were found to carry developing embryos and mature ova at the same time.

At Tuticorin a total of 513.1 t of shark and rays was landed of which sharks constituted 88.7 t and rays 347.5 t in the trawl catches and the remaining catches from drift gill nets. Elasmobranchs formed 3.9% of the total marine fish catches at Tuticorin. The size range of *D. bleekeri* varied from 76-86 cm while that of *D. uarnak* from 71-106 cm.

At Vizhinjam the landings were 41 t forming 0.4% of the total marine fish landings. Of this 20 t were sharks and the rest rays. Hooks and line accounted for 41% of the elasmobranch catch, drift net 30%, boat seines 22% and Konchu vala 7%. Elasmobranch landings were there in all months except August and November. The largest catch (240 kg) was in February and highest 15,241 kg in January. The CPUE for all the gears were very low, ranging from 0.27 to 0.54 kg. Sharks mainly *Carcharhinus* sp .and *Sphyrna* sp. were less than 1.5 m. Rays included species of *Dasyatis* and *Aetobatus.*

At Cochin the catch was 556.6 t from the fishing harbour. Drift nets accounted for 529.3 t and the remaining by the trawlers. There was a good shark fishery during the 2nd and 3rd quarters. *Carcharhinus limbatus* formed 85% of the shark landings. The size range was 62-182 cm with a mode at 95 cm.

At Bombay a total of 4361 t was landed from the New Ferry Wharf and Sassoon Docks. The bulk of the catch (79%) was from the New Ferry Wharf with a CPUE of 153 kg. The highest CPUE of 273 kg was in April.

Assessment of the resources of flat heads, lizard fishes and flat fishes along the south west coast (FB/DR/14)

C. Mukundan, V. D. Deshmukh, Grace Mathew, and K. V. S. Nair

Salient features: Analysis of the catch and effort data was made on the fisheries at Bombay, Cochin, Vizhinjam and Madras along with observations on the biology of important species. The work was initiated this year and the basic picture of the availability and species composition emerged.

Work done: A total of 2,183 t of the three groups was landed at Bombay (New Ferry Wharf), and constituted 4% of the trawler catches. *Saurida tumbil* made up a total of 1,002 t, at the catch rate of 39.5 kg/unit (trip). The highest landings were in October and the lowest in January. An estimated 1,175 t of flatfishes were landed, at the rate of 46.4 kg. September gave the best catch, at the rate of 232.2 kg. and June the poorest. Species of *Cynoglossus* and *Psettodes* made up the catch. Flatheads were stray in the catches.

At Cochin an estimated catch of 874 t of lizardfishes *(Saurida tumbil* and *S. undosquamis)* was brought by trawlers, at the rate of 19.4 kg/unit. Peak abundance was in May-August. The trawlers also landed 1582 t of flat fish, at a CPUE of 8 kg, the peak landings being in June-July. *Cynoglossus macrostomus* was the dominant species. Flatheads were relatively less abundant, 506 t at the rate of 2.5 kg, the bulk of the catch being in the first quarter. *Platycephalus maculipinna* was the dominant species.

The landings of the three groups were irregular and meagre at Vizhinjam, as demersal gear were not much in operation. Only 17 t of lizard fish, mainly *S. undosquamis* and *S. tumbil* to lesser extent, were landed. The bulk (88%) was by mechanised hooks and liners, 0.6% by non-mechanised gear, 5.6% by boat seine and the rest by Konchu vala. The CPUE ranged from 2.2 kg in August to 0.05 in May. A total of 1958 kg. of flatfishes was landed, at the rate of 0.9 kg/unit. There were only stray catches of flatheads, mainly from the survey by the departmental boat in inshore areas.

An estimated 347 t of lizard fish were landed at Madras (Kasimode) by private trawlers, forming nearly 5% of the trawl catch. The catch rate was 7.9 kg/unit. Maximum catch and rate were in October. *S. undosquamis* constituted 91% and *S. tumbil* the rest.

Mariculture of fin-fishes (DF/CUL/1.7)

R. Marichamy, K. M. S. Ameer Hamsa, P. Bensam, V. S. Rengaswamy, A. Raju V. Gandhi, P. Nammalwar and G. Mohan Raj

Salient features: Experiments on culture of marine fin fishes in coastal ponds developed at Tuticorin, Mandapam and Muttukadu (Madras) were continued.

Work done: At Tuticorin during the first half of the year, maintenance work was carried out and ponds manured with organic fertilizers. The bloom was raised prior to release of fish seed. The grounds and season were identified for collection of seed of *Lates calcarifer, Chanos chanos, Liza macrolepis, Therapon puta* and *Etroplus* sp. Palayakayal lagoon and adjacent backwaters provided good grounds for collection of fry and fingerlings. Stocking in 4 ponds were completed during December-February. Rice bran and groundnut oil cake formed the diet for milkfish, mullet and pearl-spot. Trash fish and live fish fry from the wild were given to sea-bass. *L. macrolepis* showed a growth rate of 24 mm/

month and *C. chanos* showed a monthly growth of 45 mm. Seed of *L. calcarifer*, stocked during early February 1987 in a 0.25 ha area at 100 mm/15 g, had grown to 141 mm/37 g, a monthly growth rate of 40 mm/22 g. *Therapon* sp. and *Etroplus* sp. showed a more or less uniform growth rate at 27 mm/month. These two species were stocked together while milk fish stocked with *Penaeus indicus*, as compatible species.

At Mandapam *C. chanos* were stocked in 4 ponds and two sets of experiments, with and without supplementary feed, were carried out. Growth was higher with supplementary feed. In these ponds the growth of milkfish was 23 mm/23.5 g and 28 mm/25 g, whereas in control ponds it was 14 mm/13 g and 14 mm/3.7 g. Attempts were made to collect *Sillago* sp. seed, but there was heavy mortality during transportation and stocking.

A Madras *C. chanos* were reared in net-pens of 0.01 ha size. With a high survival of 85-90%, production of 273-385 kg/ha/6 months was obtained. The growth rate was 24 mm/8 g and 32 mm/15 g. *L. macrolepis* was stocked in three ponds at stocking rates of 1500-7500/ha. The seed released at 25 mm grew to 161-181 mm/50-60 g in 7 months and the production varied from 72-226 kg/ha. It was seen that with lower stocking the growth was higher. Polyculture experiments with *L. parsia*, *M. cephalus* and *L. tade* at the rate of 5000/ha are in progress at Muttukadu.

Control of tilapia in mariculture systems (DF/CUL/1.8)

P. BENSAM

Salient features: The project was initiated to study the infiltration of tilapia into the culture site and their role as a pest.

Work done: Studies were made on the tilapia populations found in the Pillaimadam lagoon and their intrusion into the culture pens. In four chanos culture pens put up in October, 1985, with a total water area of 1.25 ha (one of 0.5 ha and three of 0.25 ha each), 30.5 kg of tilapia *Oreochromis mossambicus* were caught in early April and 2 kg by the end of April. The fishes in total length ranged from 95-215 mm and weight from 50-150 gm. These were all below stage III of maturity until June, 1986. In July however, one female (165 mm) was observed in a pen, in advanced maturity (stage V).

Seed production of mullets (DF/CUL/1.9)

P. NAMMALWAR, G. MOHAN RAJ, L. KRISHNAN M. K. GEORGE, P. BENSAM, V. S. RENGASWAMI A. RAJU, V. GANDHI and R. S. LAL MOHAN.

Salient features: Breeding and mass scale larval rearing of grey mullets were attempted at Narakkal, Calicut, Madras and Mandapam.

Work done: At Narakkal, spawners of *L. parsia* and *M. cephalus* were

collected from Chinese dipnets at Cochin barmouth area of Vypeen. Maturing and mature females and milt-oozing males of *L. parsia* were available throughout the year. *M. cephalus* spawners largely males were mainly caught during October-April.

Thirteen females of *L. parsia* were selected for carp pituitary hormone treatment. The fertilization rate was 30 to 80% and 6000 to 50,000 larvae were hatched out in the thirteen experiments. Around 2000 juveniles survived beyond 40 days of laboratory rearing.

Priority was given to breeding of *M. cephalus*. 10 breeders were used in experiments upto the third quarter but with partial success. During the last quarter, a breakthrough in hormone-induced spawning, fertilization and larval production of *M. cephalus* was achieved. The breeders were maintained in 1.2 t holding tanks with continuous change of water and use of antibiotics. Induced maturation of female *M. cephalus* was achieved under brackishwater conditions. Ovulation & natural spawning were achieved by increasing the salinity to about 31‰ towards the end of the experiment With the successful fertilization, about 5 lakh larvae hatched out. The fecundity of *M. cephalus* (54 cm and 2 kg) was four million. The fertilization rate was 60% (24 lakhs) and hatching rate 2.5% (5 lakhs). Heavy mortality of larvae occurred towards the end of the second day of rearing, except for larvae stocked in cement tank which survived upto ten days. About 450 juvenile hybrids of *L. parsia* male and *L. macrolepis* female produced last year, were stocked and reared in a 0.02 ha pond.

At Calicut two specimens of *M. cephalus* in advanced stages of maturity, (1200 g and 450 g) were used for induced spawning experiments with HCG, with doses of 0.8 - 2.21 U per g wt. The fishes died after 24 hrs and 48 hrs.

At Madras, breeders of *M. cephalus, L. tade* and *L. parsia* were collected from coastal waters and estuaries at Kovalam. Six males and four females were used for carp pituitary hormone (CPH) and HCG treatment. The fishes died after 48-72 hrs. due to stress.

At Mandapam studies on lab-lab in Pillaimadam lagoon revealed a thin natural mat of not more than 3 mm thickness, composed of *Phormidium* sp., *Coscinodiscus* sp., *Pleurosigma* sp. and *Nitzchia* sp. The units of these in each sq. cm. sample in the natural state were *Pleurosigma* sp. (64), *Coscinodiscus* sp. (42), *Phormidium* sp. (215) and *Nitzchia* sp. (31). The mean length of *Phormidium* sp. filaments in nature was 0.07553 mm. For enhancing the growth, 500 gm of N.P.K. applied in a 3.7 m enclosure during June 1986, was found to yield a 6 mm increase in thickness after a period of 13 days, whereas the control showed a 3 mm increase.

PHYSIOLOGY, NUTRITION AND PATHOLOGY DIVISION

During 1986-87, the Division was engaged in 19 research projects. These projects have been mainly directed on the candidate species of fishes and shell-fishes on which the Institute has been endeavouring to develop and perfect the technologies of culture. Subject-wise, three projects related to investigations on the reproductive physiology of the grey mullets and milkfish; 5 projects on the physiological aspects of penaeid prawns and one project on the ecophysiology of the edible and pearl oyster; 3 projects, one each pertained to the nutritional aspects of mullets/milkfish, penaeid prawn larvae and the bivalve larvae. The pathological aspects of finfishes & prawns formed the subject matter of 3 projects. With the strengthening of the Division, three projects were initiated on genetical aspects of fishes during the year.

REPRODUCTIVE PHYSIOLOGY OF FISHES

Controlled breeding of grey mullets (PNP/3)

L. KRISHNAN and M. K. GEORGE

Three female speciments of M. cephalus were brought to the laboratory in June, 1986. As the ovarian biopsy of two specimens revealed inadequate maturity of the gonad for inducement, they were maintained in the laboratory in different salinities under controlled conditions. To induce maturation of the ovary, they were administered a constructive CPH dosage of 10 mg followed by a second dose after 4 days. One of the specimens was maintained in filtered, aerated and antibiotic treated brackishwater of 15‰ salinity and the other in 33‰ salinity for 14 days when they succumbed.

In December, 4 males and 1 female were procured and maintained in the laboratory for further growth and maturation. In January 1987, one female M. cephalus measuring 540 mm in total length and weighing 2 kg was caught from the wild and treated with CPH, HCG and MPH following the results of the previous experiments. The salinity of the medium was also manipulated to induce ovarian maturation from the tertiary stage to the final stage. After 4 days the specimen spawned releasing viable eggs and about 5-lakh larvae were obtained. They survived for 10 days.

Brood stock management of milkfish (PNP/20)

M. K. GEORGE, A. RAJU, V. GANDHI
V. S. RENGASWAMY and M. K. ZACHARIA

Due to the paucity of proper brood fish, breeding experiments could not be carried out. However, the brood stock maintained in the tide fed earthern ponds at Mandapam was aug-

mented with 30 numbers of one-year-old milkfishes reared earlier in the pen culture system in the lagoon. Biopsy of the ova of the 5-year-old brood stock maintained at Mandapam showed that the gonad was undeveloped. To accelerate maturation, protein rich compounded diet with appropriate level of lipids was formulated to feed the stock.

Hypothalamic control of gonadotropic functions during maturation in female mullets (PNP/26)

M. K. ZACHARIA

This project was initiated as a corollary to the project on controlled breeding of mullets, to understand the complex endocrine control by the hypothalamus during maturation. Through histological sections and using eosin-haemotoxylin staining, the identification of the hypothalamic nuclei, nucleus preopticus (NPO) and nucleus lateralis terminalis (NLT) of *Liza parsia* was made. In the brain, anteroposteriorly, these nuclei were found to be between 2-2.7 mm and sagittally between 0.7-1.5 mm. The NPO fibres seem to have close connections to the pituitary through the NLT fibres. The cell types appear to be numerous and secretory in the mature female. The identification of different cell types using special stains are in progress.

PHYSIOLOGY OF PENAEID PRAWNS

Studies on the hepatopancreas of penaeids (PNP/15)

D. C. V. EASTERSON and D. KANDASAMI

The hepatopancreas of *Penaeus semisulcatus* was studied for its biochemical composition and carotenoid content. In *P. semisulcatus* the hepatopancreas constituted 0.26-3.13% of the wet body weight. The moisture content was about 77%. It contained more lipid than carbohydrate and protein. However, carbohydrate recorded was higher than protein. The hepatopancreas was highly pigmented due to the presence of carotenoids, the contents and composition of which was found to vary within the organ. The carotenoid content ranged from 5.6 to 84.6 mg/g and males seemed to contain higher amounts than females. The prawns in the ecdysial stages of A & D, contained higher amounts of the pigment than those in stage B.

A comparison of the capabilities of juvenile and adult *Penaeus monodon* to regulate osmolality concentration in haemolymph (PNP/23)

A. D. DIWAN and A. LAXMINARAYANA

This project was initiated to understand the osmotic response and osmoregulatory capabilities of the prawns at different stages of growth to the seasonal salinity variation in the grow-out ponds. *P. monodon* measuring 170-200 mm total length collected from the grow-out ponds were acclimatised for 48 hours in the brackish water medium of 21‰ salinity in the laboratory. Triplicate experiments were conducted by subjecting the acclimatised prawns to hypo and hypersaline media ranging from 0-45‰ for 24 and 48 hours and the osmolal concentration of the media as well as the haemolymph of the prawns determined. The results indicated that the prawns survived were in the salinity between

3‰ and 45‰ regulating their physiological processes. In freshwater, the prawns died within 24 hours. The iso-osmotic points for 24 hours and 48 hours were found to be around salinities of 18.5‰ and 23.5‰ respectively.

Experiments were also conducted on the eyestalk ablated prawns, normal prawns and destalked prawns injected with eyestalk extract to understand the eyestalk factors controlling the osmotic concentration. It was observed that in the destalked prawn injected with eyestalk extract, the omsolality values of haemolymph were of relatively higher profile throughout the period than that in the eyestalk ablated prawns without the administration of eyestalk extract. This indicated the involvement of eyestalk factors in controlling osmotic concentration of the haemolymph.

Distribution of phenol oxidase enzyme and its role in hardening of the cuticle in penaeid prawn (PNP/24)

A. D. DIWAN and N. SRIDHAR

This project envisages study of the physiology of hardening of the exoskeleton of *Penaeus indicus* after moulting. After standardising the methods for determining the phenol oxidase enzyme activity with different substrates, the various parts such as antennule, antennal flagella, rostrum, carapace, mandible, uropod of *P. indicus* in the inter-moult stage were analysed for phenol oxidase enzyme using L-Dopa as the substrate. It was found that the antennule and antennal flagella exhibited an activity of 5.55 x 10^{-5} μ moles/ml/5 minutes; antennal scale 4.166 x 10^{-6} μ moles/ml/5 minutes; telson 1.11 x 10^{-4} μ moles/ml/5 minutes. Phenol oxidase activity was not detected in the mandible, rostrum, carapace and uropod.

Seasonal changes in certain biochemical components and their allocation to gonad and soma in *Metapenaeus dobsoni* (PNP/7)

N. SRIDHAR

Significant progress on the experimental aspect of the project could not be achieved, as the Scientist was undergoing foundational training at NAARM, Hyderabad during half of the period under report. However, samples of M. dobsoni were stocked at —20°C for estimation of protein and fat at different maturity stages.

Metabolic adaptation of the cultivable species of prawn in relation to different environmental factors (PNP/32)

M. PEER MOHAMMED and M. K. ZACHARIA

Initiating the project in August 1986, the methodology and design of experiments to study the impact of various environmental factors on survival, respiratory metabolism and random activity of prawns were standardised. A static and recirculating running water systems were set up to conduct the experiments.

PHYSIOLOGY OF MOLLUSCA

Ecophysiology of oysters and chank (PNP/25)

D. C. V. EASTERSON

Research was carried out on two aspects, one on the influence of feeding on the lustre and colour of the

nacre secreted by *Crassostrea madrasensis*, and the other on the biochemical composition of the oyster during different maturation stages. In the former study, spats (3-5 mm) of *C. madrasensis* obtained from the hatchery were fed with *Isochrysis galbana* along with ferrous citrate @ 8, 4, 2 nanograms/litre. Slight rosy discolouration of the nacre was observed in 2%of the animals fed with *I. galbana* with ferrous citrate at the rate of 8 ng, after one and a half hours.

The biochemical analysis of the mantle, gills, adductor muscle and the visceral mass of *C. madrasensis* showed a moisture content of 79.50, 81.11, 78 and 77.93% respectively, and an ash content of 6, 6.6, 5.6 and 3.9% Moisture and ash content showed only little variation in different maturity stages. Similarly, the lipid content did not show any marked difference between the sexes. Appreciable fluctuation of lipid content in the mantle at different maturity stages was recorded in the oysters.

NUTRITION

Nutritional requirements of fry and fingerlings of the milkfish (*Chanos chanos*) and mullets (PNP/6)

R. Paul Raj, D. C. V. Easterson and D. Kandasami

Experiments were conducted to determine the nutritive value of groundnut oil and sardine oil individually and in combination in the ratio of 1:1 for milkfish fry. Three diets of same gross energy having protein levels at 40%, carbohydrate 45%, lipid content 6%, vitamin 1% and mineral mixture 3%, with gelatin as the binder, were used in the experiments. Preliminary observations on the food intake of milkfish fry indicated a preference for the diet containing a mixture of sardine oil and ground nut oil as compared to the other two diets containing individual oils. Besides, the food intake was relatively less with ground nut oil incorporated feed than that containing sardine oil. At Tuticorin, one experiment was in progress to study the relative efficacy of natural lipid resource for formulation of suitable diet for mullet fry.

Nutritional requirements of penaeid prawn larvae (PNP/9)

Syed Ahamed Ali and M. Vijayakumaran

Four micro-particle compounded diets were prepared using ingredients such as whole egg (chick), clam, milk powder, wheat flour, lipid mix (cod liver oil, sardine oil, lecithin, prawn head oil in the ratio 1:1:1:1), sodium alginate, vitamins, minerals and calcium chloride, with varying composition of the first four ingredients for rearing *P. indicus* larvae. The diet was first prepared using alginate & calcium chloride sprayed at the end, so that the calcium ion coupled with alginate to form an effective binder coating on the diet particles. The particle size of the diets was about 50 microns.

Studies on the effect of food additives as stimulants for larvae, juveniles and adult prawns (PNP/21)

R. Paulraj

Isonitrogenous and isocaloric pelleted diets were prepared with 35%

protein, 41% carbohydrate, 10% lipid, 0.5% cholesterol, 2% vitamin premix and 4% mineral premix, using agar agar (15%) as the binding agent. Glycine and glutamic acid were used at 1% and 0.5% levels. The non-essential amino acid, alanine was used to replace glycine, taurine, and glutamic acid in the control diet. Experiments were conducted with these diets on juveniles of *P. indicus* (20-30 mm total length) for 30 days. The test prawns were fed with excess diet once a day in the afternoon, and the left over food removed the following day. Among the four diets experimented, the diet containing glycine was ingested by the prawns at a higher level, the ingestion rates being 26% for glycine, 19% for taurine, 16% for glutamic acid containing feeds and 17.5% for the control. Prawn fed with the diet containing glycine registered a higher growth and better food conversion rate.

Three test diets were prepared each having either phospholipid or carotenoid or steroid hormone in the basal purified diet containing casein, gelatin, egg-albumin, starch, cod-liver oil, ground nut oil, vitamin and mineral mix, to evaluate the efficiency of phospholipids, carotenoids and steroid components on the growth of the prawn. The alga, *Spirulina* sp. and silk worm pupae were procured and their chemical composition studied for incorporating these in the diet as they have been reported to promote growth in crustaceans and finfishes.

Development and evaluation of artificial and algal diet for rearing of bivalve larvae and spat (PNP/11)

D. KANDASAMI, P. MUTHIAH and A. C. C. VICTOR

Experiments were conducted with micro-encapsulated diet prepared with oyster and clam lipid extract, on the hatchery raised oyster larvae. However, due to ciliate attack, and consequent mortality of larvae, the experiments were discontinued.

The data of the earlier experiments were analysed. The percentage of spat settlement was better among the larvae fed with *Isochrysis galbana* supplemented with oyster oil extract encapsulated diet than those fed with algal diet supplemented with clam oil and fish oil extract encapsulated diet. Similarly, the percentage of weight increase in the spat fed with *I. galbana*, supplemented with 40% of oyster oil extract was higher (122%) than those fed with 20%, (97%). The weight increase of spat reared with *I. galbana* supplemented with 3 different concentrations of fish oil extract encapsulated diet ranged from 85-93%. In the control, the percentage increase was only 69%.

PATHOLOGY

Studies on pathobiology of 'soft' prawns (PNP/14)

P. VEDAVYASA RAO, S. K. PANDIAN and N. SRIDHAR

The relationship between the oxidation-reduction potential of the pond bottom and the occurrence of 'soft' prawn syndrome was studied from the Institute's ponds at Narakkal (near Cochin) and from a 15.4 ha perennial field at Narakkal. At the Narakkal

farm, the Eh value of the pond bottom was —201 in the first half of July when the stocked prawns *(P. indicus)* were healthy. In the third week, when the Eh was —219, 8.7% of the stocked population in the pond were in the initial stage of 'soft' condition. As the season progressed, the average Eh value increased to -276 by the third week of August when 21% 'soft' prawns were encountered. Although, the Eh of the pond bottom in the first week of September reduced to —73, the percentage occurrence of 'soft' prawn was 62.

In another pond, the state of oxidation-reduction of the pond bottom was found to fluctuate between —103 and —702 during July-September, and the percentage of 'soft' prawns, from 25 to 68.4.

In the perennial field, the readings of oxidation-reduction potential of the bottom varied from +352 to —364 and was found to be scattered in a mosaic pattern. These data, showed that, as the bottom of the pond showed progressive reduction, the percentage of 'soft' prawns increased and once the 'soft' condition set in due to increased reduction, the phenomenon did not reverse appreciably even when the bottom conditions showed improvement.

Studies on the pathobiology of captured and cultured fin-fishes (PNP/28)

S. C. Mukherjee and K. C. George

Nemipterus japonicus, Saurida tumbil, sciaenids, *Mugil cephalus, Liza parsia, Epinephelus diacanthus, Trichiurus lepturus* and *Tachysurus thalassinus* were surveyed for incidence of diseases and abnormal conditions. Mortalities in fingerlings and young mullets in the culture ponds were also investigated.

Grossly, lesions due to internal injuries, moderate to severe congestion of gills, blood clots in the thoracic cavity, thickenings, congestion and haemorrhages of stomach mucosa, were encountered in *N. japonicus*, S. *tumbil, E. diacanthus, T. lepturus* and *T. thalassinus*. In one *N. japonicus*, a pea-size nodule was seen in the gastric mucosa and the liver was pale and discoloured. In *E. diacanthus*, gill necrosis, fin rot and small greyish white foci resembling parasite nodules in the gills & peritoneum were recorded. The mullet fingerlings showed stunted growth, as they had several ulcerative lesions in the skin, near the head. Histopathologically, the lesions were characterised by marked necrosis with extensive proliferation of polymorphonuclear cells and a few mononuclears. The liver showed extensive degeneration of hepatic cells. Severe congestion, bacterial colonies and lamellar hyperplasia and hypertrophy were observed in the gills.

In addition, abnormal behaviour of fishes and prawns in a farm near Cochin was investigated. It was found to be due to oxygen depletion and acidic pH of water. *Vibrio* sp. was present in gills and muscles of prawns from this field. The examination of the mortality incidence reported for the larvae of *P. indicus* in the experimental hatchery at Narakkal showed the

presence of certain protozoan infestation. Further work was continued.

Studies on the mortality of fish/prawn at Muthukadu mariculture farm (PNP/29)

M. VIJAYAKUMARAN and E. V. RADHAKRISHNAN

Mortality of fishes and prawns stocked at Muthukadu near Madras have been observed regularly every year. Although the intensity of mortality varied from year to year, it was severe in 1983. This project was taken up to study this phenomenon.

In 1986 summer, unlike in the previous years, the water level in the ponds was relatively high and no specific phytoplankton blooms were noticed, although the salinity increased above 80‰ in some of the ponds in the 'B' series. With the failure of the north-east monsoon, the condition of the ponds deteriorated and the salinity increased above 100‰ in February. Consequently elvers, crabs and prawns in the farm succumbed.

Examination of fishes and prawns showed the incidence of an isopod parasite in *Nematolosa nasa* in its gill chamber. The affected gills were eroded at the site of attachment and at other places by the growth of the parasite pressing against the gills and the operculum. The incidence of the parasite was about 20% in *N. nasa* population in the area. *Oreochromis mossambicus* collected from the farm had *Gyrodactylus* sp. a monogenean, monopisthocotylean helminth parasite on the gills. Epidermal hyperplasia was observed at the site of attachment. Gill rot and extensive necrosis, melanisation, epidermal hyperplasia and tip fusion in the secondary gill lamllae were also encountered in the affected fishes. Gram negative bacteria, protozoa and fungal hyphae were also seen in these fishes. In isolated instances, telangiectesis of the gill was encountered. Enlargement of spleen and liquefaction of kidney was also observed in the fishes collected in October and November. *P. indicus* and *M. dobsoni* sampled from the feeder canals in October showed 'soft' condition. Histopathological observations on the tissues of affected fishes and prawns are in progress.

FISH AND SHELLFISH GENETICS

Genetic damage induced by environmental mutagens and toxins on commercially important marine fishes (PNP/30)

GEORGE JOHN, K. J. EAPEN and A. G. PONNIAH

Etroplus suratensis was selected as a candidate species for assessing the genetic damage caused by environmental toxicity and pollution. Screening of fish for its karyotype, the colchicine treated kidney, spleen and gill tissues were treated hypotonically, fixed, air-dried and stained with Giemsa/ Lieshman's stains. Colchicine (.01%) at the rate of 0.5 ml or 1 ml per 100 g appeared to be inadequate in sufficiently increasing the frequency of metaphase spreads.

A genetic study of quantitative and and qualitative variation in *Rastrelliger kanagurta* using biochemical and population genetic techniques (PNP/31)

K. J. EAPEN, GEORGE JOHN and A. G. PONNIAH

The project was discontinued consequent on the preparation and submission of a similar project as an adhoc project of ICAR.

Studies on the genetic variation in the edible oyster *Crassostrea madrasensis* and the pearl oyster, *Pinctada fucata* (PNP/32)

A. G. PONNIAH, K. J. EAPEN, GEORGE JOHN and T. S. VELAYUDHAN

Determination of the basic protein pattern of *Crassostrea madrasensis* and its differences in the individuals of Cochin population was initiated. After standardising the optimum acrylamide and bisacrylamide combinations required to obtain maximum bands and the amount of tisues required for the basic electropherogram, four tisues, i.e. mantle, adductor muscle, gills, and diverticula were analysed for basic protein band patterns. The number of bands observed in the mantle, adductor muscle, gills and diverticula were 12, 12, 17 and 14 respectively. More than half of these were faintly stained. The clear bands observed were 9, 11, 9 and 11 bands respectively in the adductor muscle, mantle, gills and digestion diverticula. In the adductor muscle, the presence of polymorphic loci was detected in band 6 and 9.

At Tuticorin, studies on selective breeding of *P. fucata* and sequential settling of spat were taken up. Pair mating was carried out to produce 100% spat without black lamellar growth on the shell. The spat selected for black lamellar growth showed better growth and weight than that without black lamellar growth.

FISHERY ENVIRONMENT & MANAGEMENT DIVISION

During the year the Division handled research projects on various aspects such as fishery oceanography, primary and secondary production, remote sensing, marine pollution and on endangered species and specialised ecosystems and the progress was generally good.

Physical and chemical aspects of the waters of the EEZ (MBO/ES/1.1)

A. V. S. MURTY, C. P. RAMAMIRTHAM, D. S. RAO. S. MUTHUSAMY, K. G. GIRIJAVALLABHAN, S. KRISHNA PILLAI, C. P. GOPINATHAN, and C. V. MATHEW

A time series analysis of environmental factors and pelagic fisheries along the south west coast of India showed that the monsoon season was the net production season and the post monsoon season the net predation season. The premonsoon season served as a link season. Plankton production in the region seemed to be controlled by temperature conditions rather than dissolved oxygen content.

During 1986, the onset of monsoon was delayed and became definable in early July with the decrease of temperature (5°C) in the bottom waters off Cochin as also of dissolved oxygen content. The upwelling was intense by the end of July and its presence was felt till the middle of November. The pelagic fishery in the region during the past three years was studied to correlate the environmental factors such as intensity and persistence of upwelling.

Oceanographic parameters in relation to demersal fisheries (FED/Misc/17)

C. P. RAMAMIRTHAM and S. MUTHUSAMY

Based on oceanographic data collected by R. V. *Varuna* during 1964-65, distribution charts for various oceanographic parameters along the south west coast of India were made to study the relevant environmental parameters including current pattern and the abundance of demersal resources in the region.

Fishery oceanographic investigation in the Laccadive Sea (FED/Misc/18)

C. P. RAMAMIRTHAM, A. V. S. MURTY, S. MUTHUSAMY, I. DAVID RAJ and R. V. SINGH

In February, 1987 the oceanographic conditions of Lakshadweep waters were surveyed during the cruise of FORV *Sagar Sampada*. It was observed that the thermocline was present at an average depth of 80 m for the surface. Weak temperature inversion was noticed in the depth range 20-30 m and the average temperature of the mixed layer was about 26.7°C. The surface salinity was in the order of 35.2 to 35.5 ppt and dissolved oxygen around 4 to 4.2 ml/l. The biomass

of zooplankton collected ranged from 10 ml to 70 ml/m^3. The common plankton were siphonophores, chaetognaths, copepods, ctenophores, euphausids and medusae.

Upwelling and fisheries: Model studies (FED/Misc/12)

G. Subbaraju, K. C. George, V. N. Bande, P. Kaladharan and K. Radhakrishna

Work was initiated during the year for the intensive study of upwelling in the area between Kakinada to Kalingapatnam. In July one survey was undertaken along the west coast from Quilon to Tellicherry for studies on upwelling. Multiparameter studies are being made based on data collected.

Studies on upwelling were carried out at Visakhapatnam from February onwards. Upwelling as indicated by incursion of cold, highly saline waters rich in nutrients and very low in oxygen were discernable at 50 m and their shoreward movement to 30 m could be traced.

Changes in oceanographic features in relation to oil sardine and mackerel fishery (FED/Misc/19)

V. Narayana Pillai, D. Sadananda *Rao*, A. Noble, K. V. Narayana Rao, G. Luther and M. Rajagopalan

Based on monthly distribution charts of temperature, salinity and dissolved oxygen, oceanographic features such as upwelling off Cape Comorin, Quilon, Cochin and Kasaragod have been studied in relation to oil sardine, mackerel and anchovy fisheries in this area. The 23°C isotherm and 1 ml/l oxygen content isoline were identified as showing maximum oscillation. Steps were taken to obtain NOAA data for attempting correlation studies utilizing remote sensing data.

Application of remote sensing to fisheries (FED/RS/1)

G. Subbaraju, V. N. Pillai and V. S. K. Chennubhotla

As part of the IRS utilisation programme, six coverages were made during the year in the area between Malpe to Quilon for collection of sea truth data such as productivity, chlorophyll-a, pheophytin, particulate matter, radiance etc. utilizing under water radiometer. Pigment and productivity maps are being generated from these coverages for possible correlation with fisheries in the area.

Studies on the possibility of utilising remote sensing data for locating areas of upwelling on the continental slope along the South-West Coast of India (FED/RS/2)

V. Narayana Pillai

Analysis of basic oceanographic data (sea water temperature, salinity and dissolved oxygen) pertaining to Cochin, Kasaragod, Karwar and Ratnagiri for the purpose of finding out suitable upwelling indices was completed. Vertical time series sections of sea water temperature and dissolved oxygen indicated the possibility of tracking the 23°C Isotherm and 1 $ml0_2$ /L Isoline for dissolved oxygen content for

the purpose of locating and monitoring the process of upwelling on the continental slope between Cochin and Ratnagiri. Oceanographic data collected from the area between Ratnagiri and Cochin during October-November, 1986 on board *Sagar Sampada* has been analysed to find out the extent of correlation with individual parameters viz. sea water temperature, salinity, and dissolved oxygen. Steps have been initiated through NRSA Data Centre to obtain relevant NOAA data for the period 30th October to 7th November 1986 for attempting possible correlation studies.

Seaweed resources along the Kerala coast (MBO/SW/1.1)

V. S. K. Chennubhotla, P. Kaladharan
B. S. Ramachandrudu and S. K. Dharmaraja

From August '86 to March '87, 148 stations were surveyed along the Kerala coast from Cannanore to Poovar. The coast was divided into different ecological zones and the extent of seaweed resources studied in detail. The biomass of seaweeds ranged from 73.6 to 179.4 t in Zone I to III. The area from Kadalundi to Cannanore was more productive and had greater species diversity. 14 species of seaweeds were identified as commonly occurring in the three zones. Possible areas for commercial exploitation have been identified.

Deep water seaweed resources (IIP/7)

V. S. K. Chennubhotla, N. Kaliaperumal,
S. Krishna Pillai, Prabhakar (CMFRI;
K. Subbaramaiah and team (CSMCRI)

Under this project, 5 transects north of Tuticorin and 7 south of Tuticorin were surveyed for deep water seaweed and seagrass resources, along with studies on environmental parameters. In the depth range 5 to 20 m, 11 species of green algae, 8 species of brown algae and 29 species of red algae were found to occur. *Cymodocea* sp. and *Halophila* sp. were the common seagrass in the littoral waters.

Phytoplankton and primary productivity (MBO/PP/1.1)

K. Radhakrishna, G. S. Daniel Selvaraj,
and P. Kaladharan

Data on primary productivity and related parameters were collected weekly from 2 stations from inshore waters of Visakhapatnam.

Maximum chlorophyll a (2/mg/m^3), b (2 mg/m^3) and c (3.9 mg/m^3) were recorded in September and minimum values in October.

SST maximum (29.7°C) was observed during August-October and minimum (24.6°C) in January. Subsurface temperature maximum was at 30 m in November (28.8°C) and minimum at 30 m in March (23.4°C). Surface and subsurface salinity were the maximum in April (34.38 and 35.44‰) and minimum in October (21.85 and 21.76‰). Maximum dissolved oxygen was at surface (8.4 mg/l) and subsurface (6.0 mg/l) in December and minimum in April (surface 4.2 mg/l and subsurface 0.4 mg/l at 50 m depth). Phosphate was maximum in August and minimum in November. Nitrate (NO_3 N) was maximum in October and minimum in January. Nitrite (NO_2 N) was maximum

in January-February-March and minimum in November.

Primary production in the inshore waters off Cochin ranged between 0.33-0.68 g/m^3/day and net production varied between 50-65% of the gross production in the open waters as compared to 49-51% in backwaters. Primary production and chlorophyll-a values were more in the subsurface at 10-20 m depth than at the surface. Pheophytin was more in the backwaters.

Secondary production (MBO/PL/1.1)

K. J. Mathew, T. S. Naomi, C. V. Mathew, P. A. Thomas, Rani Mary Jacob, Pon Siraimeetan, S. Krishna Pillai, and K. G. Girijavallabhan

During the year, the Antarctic zooplankton collections were studied in detail, with reference to daily variation, spatial distribution and latitudinal distribution, especially of euphausids. The euphausids of south west coast were also intensively studied. Data on secondary production were regularly collected from Mangalore, Vizhinjam, Tuticorin, Mandapam and Madras.

Zooplankton collections of Sagar Sampada (FED/Misc/14)

K. J. Mathew and T. S. Naomi

300 samples were sorted out under zooplankton groups such as copepods, siphonophores, polycheates, fish eggs and larvae, crab larvae, larvae of penaeids, carideans and cephalopods and sent for detailed studies.

Estimation of bacterial productivity

V. Chandrika and Shankar V. Alwandi

Growth rates of heterotrophic bacteria in brackishwater and sediments have been estimated in the Cochin estuarine system, using the techniques of thymidine incorporation into DNA. Such studies were conducted in acquaculture ponds also.

Distribution of phosphobacteria (FED/Misc/15)

V. Chandrika and Shankar V. Alwandi

The distribution of phosphobacteria was surveyed from 10 m and 20 m depth stations at Cochin. A special indicator agar was used to detect phosphatase activity. Cultures are being maintained for further studies and analysis of phosphorous compounds.

Studies on benthos in relation to fisheries (FED/Misc/22)

K. Radhakrishna, Pon Siraimeetan and S. Sivakami

No distinct demarcation in the benthic population at 10 m & 20 m depth was discernable. However 20 m depth samples showed a higher density during October to January. Benthic fauna was dominated by polychaetes such as *Prionospio* sp. *Lumbrioneries* sp. *Nepthys* sp. and *serpulids*. Among molluscs, *Architectonia* sp., *Arca* sp., *Cerethidium* sp., *Dentalium* sp. and *Cavolina* sp. were common. Crustaceans were represented by amphipods. Quantitatively *Prionospio* sp. and *Architectonia* sp. were dominant. At Tuticorin, due to non-availability of boat, work could

not be initiated. The work at Visakhapatnam was initiated in the last quarter only.

Studies on boring sponges (FED/Misc./9)

P. A. THOMAS

At Vizhinjam the infection of boring sponges on gregarious molluscs such as mussels, rock oyster, *Thais*, *Pseudochama* and *Spondylus* was studied in detail. The spreading pattern of conventional species such as *Cliona celata, C. vastifica* and new infiltrants such as *Cliona margaretifema* was determined with population indices on host species.

Bioactive agents from marine organisms (FEM/BEN/1)

D. SADANANDA RAO, R. SARVESAN, D. B. JAMES, K. G. GIRIJAVALLABHAN, C. S. GOPINADHA PILLAI, P. A. THOMAS, K. K. APPUKUTTAN and C. P. GOPINATHAN

The alcoholic extracts of 118 marine organisms belonging to sponges, alcyonarians, corals, molluscs; echinoderms and flagellates were tested for lethality and toxicity on the fingerlings of tilapia (0.75-1.00 gm, 34 mm-42 mm size) and mice. The following organisms showed lethality to tilapia: (1) *Subergorgia suberosa* (gorgonid) (2) *Pentoceraster regulus* (echinoderm) (3) Alcyoniarian no. 1 and (4) Alcyonarian no. 2. The tests on mice indicated that *Autosponge tubulatus, Spirastrella inconstans, Acropora, Millipora* (form *a*) & *Surculosa* were lethal Alcyonarian no. 2 and 3, *Drupa heptagonalis, Acropora corymbosa* showed toxicity to mice producing comatose condition. Further work on the hemolytic and antimicrobial activity of these extracts are in progress.

Alginic acid and carrageenan have been isolated from *Hypnea musciformis* and the characterisation of the carrageenan into r and k types is being carried out.

Eight seaweeds were collected from Mandapam area. They were *Sargassum myriocystium, Jania rubens, Caulerpa sertularioides, Laurencia papillosa, Sargassum wightii, Ulva reticulata, Amphiroa fragillissima* and *Padina gymnospora*. They were processed for further extraction, separation and isolation of chemical compounds.

Employing the seria dilution culture technique the culture tube innoculated seawater with less than 10 micron organisms as well as natural population showed the presence of toxic flagellates such as *Dunaliella salina* and *Oxytoxum* sp. during September-October period. The red and yellow stains of *Dunaliella* sp. were tested on the larvae of edible and pearl oyster in various concentrations. The red strains of *D. salina* had more toxic effect. However, the rate of feeding was found to be less compared to the flagellate *Isochrysis* sp.

Large quantities of *Pentoceraster regubes, Goniodes coster scaber, Holothuria scabra* and *H. atra* were collected for further chemical analysis.

Drifts along the Indian coasts (FED/Misc/10)

D. SADANANDA RAO and K. G. GIRIJAVALLABHAN

3600 drift bottles were assembled and sent to 13 centres of the Institute

and arrangements were made for release of 20 bottles each every month between 13th to 17th of the month for one calendar year. The release commenced at various centres from February 1987. In general the drifts were southward along the west and east coasts during February and March. The southward drift along the east coast was weaker.

The drift bottles released at (a) Karwar were recovered at Udupi; (b) Mangalore were recovered at Munambam, Cochin after 27 days; (c) Calicut at Thottappilly after 15 days; (d) Cochin at Ambalapuzha after a week, Vizhinjam after 12 days and Colachel after 13 days; (e) Vizhinjam recovered from Pulluvila and Adimothurrai; (f) Tuticorin at Manapad after two days and (g) Madras recovered some 40 km south after 10 days. The above places are the farthest places to which the drift bottles travelled. In general there was 40% recovery.

Marine pollution (MBO/MP/1.1)

V. Kunjukrishna Pillai, D. S. Rao, V. Chandrika, R. Marichamy, M. Rajagopal, and P. V. Ramachandran Nair

The project work was carried out at Cochin and Tuticorin. Regular collection of edible oyster, *C. madrasensis* were obtained from Tuticorin. Samples collected from January 1986 to December '86 were analysed for trace metal levels (Cu, Zn, Pb and Cd) by Atomic Absorption Spectrophotometry. Zinc and copper showed maximum levels (Zinc: 115 ppm (Jan.) to 426 ppm (July); Copper: 335 ppm (Jan.) to 124 ppm (Nov.). Sediment samples were also collected from the stations and analysis is in progress.

At Tuticorin, mercury pollution levels were monitored in selected areas, especially near the industrial complex. In the lagoon near the discharge, the mercury levels ranged from 102-233 ng/ml during April-September. The pH showed the water to be acidic (1.39 to 5.95). However, no visible damage was noticed in the surrounding coastal waters.

Environmental monitoring of aquaculture systems (MBO/MP/1.2)

V. Kunjukrishna Pillai, I. David Rao, R. V. Singh, P. V. Ramachandran Nair, Geetha Bharathan, M. Rajagopalan

At Cochin, three different types of aquaculture systems were regularly monitored. Water samples were collected from the ponds and data on temperature, pH, salinity, dissolved oxygen, inorganic phosphate, nitrate, nitrite and ammonia were collected. Sediment samples were collected once in a quarter for physical and chemical analysis. Benthos of the ponds were also collected. In the ponds, salinity showed a range of 2.9‰ in July to 24‰ in Jan-Feb. Dissolved oxygen levels were normal, except in September-October (lowest value recorded being 2.10 ml/L). Nutrient values did not show any significant variations, except for high levels of ammonia (upto 30 g/l) in some of the newly dug out ponds where ammonia was used for eradication purposes. The analysis of sediment samples showed that the percentage of organic carbon in the paddy

cum prawn culture fields was high (4.08-4.22) compared to the newly constructed ponds (0.24-1.22). The grain size analysis of the soil samples showed that silt and clay fractions were higher in the paddy cum culture system indicating a higher fertility status.

At Madras, regular monitoring of environmental parameters from selected ponds at Muthukkadu mariculture farm was carried out. Data on water temperature, pH, salinity, dissolved oxygen and primary productivity were collected. Sediment samples were analysed for organic carbon and available phosphorus. The liming rates for the pond soils were also estimated. Water temperature showed a range of 25.5 - 33°C. Salinity ranged between 23.39‰. Dissolved oxygen values ranged between 2.82 to 5.3 ml/l. Primary productivity was comparatively high during April-August (94 to 1115 mg C/m^3/day) and the minimum was observed in September-January (0-330 mgC/m^3/day). The sediment analysis showed that the soil pH varied between 7.64-8.78. The organic carbon ranged from 0.12-0.56% and available phosphorus was between 4.5 ppm-14.68 ppm. The liming rates estimated showed a range of 224-1120 kg/ha of $CaCO_3$

Ecological studies of mangrove swamps (MBO/MS/1.1)

M. S. Rajagopalan, G. S. D. Selvaraj and A. Kanagam

A rapid resurvey of the mangrove habitats in the Cochin estuarine system was undertaken to study the vegetational changes during the past years. Compared with the data collected in 1977, it was observed that the vegetation cover had reduced by 50% in the harbour islands and adjacent areas. However, in the Vypeen island, Narakkal, Vallarpadam and Thanthoni islands the vegetation cover increased and species such as *Bruguiera cylindrica* were freshly established.

The samples of bottom epifauna collected from Kakinada mangroves were analysed and it was observed that juvenile prawns constituted about 85-90%. The common species were *P. indicus, M. dobsoni* and *M. monoceros.*

Studies on seepage of soils (FED/Misc/20)

B. S. Ramachandrudu

The combinations of replicated lined trapezoided channels were subjected to water fill in sandy soils. The seepage rate was determined by ponding method.

From the analysis it was observed that the seepage rate in cement concrete channel was significantly low at 1% level over all the other combinations including control. However, taking the cost of fabrication into consideration the cement mortar lined channel was significantly superior over the other combinations in arresting the seepage by 87% and the cost was Rs. 7.80/sq. m.

The order of preference of the next best combinations was 1:10, 1:8 and 1:6 cement mortar lined channels costing Rs. 7.80, 8.38 and 9.00/sq.m. and allowing water through linings by

25.91, 22.58, 21.35 litres/sq. m/day respectively. A wide range of upper control limit as well as lower control limit was exhibited at large seepage rates especially control channels 853 + UCL 1081.64, – LCL 624.85 litres/sq.m/day.

The seepage rates of sandy soils of Arthinkal to Kalloor belt, Alleppey district, Kerala State are similar to the available data of Davarapally belt, West Godavary Dt., Andhra Pradesh. This is the additional information gathered.

Investigations on the biology of marine turtles in relation to the conservation and management of the resource. (MBO/MM/1.1)

P. S. B. R. James, M. Rajagopalan, S. S. Dan, A. Bastian Fernando, V. Selvaraj

A hatchery was set up at Kovalam to incubate the eggs of olive ridley turtle *Lepidochelys olivacea*. In the 1986 season 3973 eggs were collected for the recovery programme and 1881 eggs hatched (48%). The diameter of the egg varied from 32.5-42.5 mm and weight from 22.0-36.3 gm.

The size and weight of hatchlings emerged after 45 to 49 days were : carapace length (31.9-44.5 mm); carapace width (27.3-38.0 mm); weight (12.0-21.8gm).

At Kovalam from 19-12-86 to 10-1-87 a total of 1543 eggs from 13 clutches were collected and kept at the hatchery. The hatchlings of 1986-87 batch emerged after 46 to 49 days.

In January 1987 the Gahirmatha turtle rookery, Bhitarkanika Wildlife sanctuary, Balasore District, Orissa was visited and data collected on the arribada or mass nesting of olive ridley *Lepidochelys olivacea*. The arribada occurred in a stretch of 5.7 km beach from 5.1.87 to 14.1.87. Approximately two lakhs of olive ridley turtles nested. The size of nesting females of olive ridley observed is given below :

carapace length 66.0-76.0 cm (70.8) and carapace width 60.5-75.5 cm (68.8), (curved method); carapace length 61.0-71.0 cm (65.9) and carapace width 53.0-65.5 cm (57.6) (straight line method).

Data were collected on the area of nesting, duration of nesting, depth of nest, nest temperature, ambient atmospheric temperature, clutch size and distance of pit from the high water mark. Freshly laid eggs from the ten clutches were collected at random and the diameter and weight were recorded.

During the year 1987 about 360 caracasses of olive ridley were washed ashore in different states of decomposition in a stretch of 11.7 km. This is lesser than the numbers in earlier years. Both the males and females were noticed and measurements of caracasses were taken.

The width of the beach from the highwater mark was measured at every 200 m for the entire stretch of 11.7 km to determine the dimension of beach erosion and the availability of nesting area. The width of the beach played a vital role in the selection of nesting site by the turtles.

FISHERY ECONOMICS AND EXTENSION DIVISION

Socio-economics of the traditional fishery at Vizhinjam and Calicut areas of Kerala state (FE & E/1.1)

R. SATHIADHAS and K. K. P. PANIKKAR

Socio-economic surveys of fishermen households at Poonthura in Vizhinjam area and Quilandy in Calicut area were completed. The cost and earning data for the sample units of catamarans and canoes fitted with outboard motors at Poonthura were collected for a period of one year upto July 1986. The average initial investment of a catamaran unit worked out to Rs. 5,440 (Rs. 2,800 for logs and Rs. 2,640 for gears). For OBM units it was Rs. 40,626 (OBM Rs. 13,000, canoe Rs. 7,750 and gears Rs. 19,876).

Economics of mechanised fishing units (FE&E/4.1)

K. K. P. PANIKKAR, T. JACOB and R. SATHIADHAS

The collection of cost and earning data from trawlers of different sizes operating in the Tuticorin region was completed and tabulation work carried out.

At Mangalore and Malpe centres the data on fixed and operational costs relating to purse-seiners, trawlers and gillnetters were collected on sample basis during the period from April 1986 to March 1987. Analysis of the data was initiated.

Economics of trawling by utilizing wind energy in Tamil Nadu (FE&E/4.2)

R. SATHIADHAS

Data on input-output of sample units representing indigenous boats operating trawlnets and other type of nets by utilizing wind energy and motorised boats of same size operating different types of nets at Therespuram and Tuticorin south landing centres have been collected for two seasons during the year.

Economics of gillnet fishing by OBM & IBM boats in north-west coast (FE & E/4.3)

D. B. S. SEHARA

Data collection from sample units was initiated in September '86 from 2 centres in Maharashtra operating inboard motor (IBM) boats and one each in Maharashtra and Gujarat operating out-board motor (OBM) boats. Collection of data regarding variable cost and returns proposed to continue upto August '87.

Economics of different types of fishing units in Orissa (FE & E/10.1)

KAMALKUMAR DATTA

Analysis of economic data of different types of fishing units in Orissa

showed that the annual gross return of a mechanised boat operating gillnet was about Rs. 81,500 at Bahabalpur and Rs. 97,600 at Talsari in Balasore district. The annual gross income from a Dingy type non-mechanised country-craft with gillnet was about Rs. 46,500 at Bahabalpur and Rs. 20,500 at Talsari, both in Balasore district. The annual gross revenue from a 'Nava' which operates different mesh size gillnets in different seasons within a year was Rs. 79,680 at Badapadia (Cuttack district), Rs. 16,500 in Gopalpur (Ganjam district) and Rs. 7,200 in Puri (Puri district). The gross income from a 'Tappa' was Rs. 54,200 at Badapadia, Rs. 11,100 at Bandar and Rs. 2,130 at Puri. From trawl units at Balaramguri, residual return to capital was Rs. 1,25,570 and higher than that of Paradeep (Rs. 44,930). During 1985-86, by spending one rupee, a Paradeep base trawler added 29 paise whereas at Balaramguri it added 50 paise in the net value added system.

An evaluative study of the extent of knowledge gained by rural women through training programmes in prawn/fish culture (FE & E/12.1)

KRISHNA SRINATH

A study was carried out to evaluate the utility of the training programmes in prawn culture conducted by the Krishi Vigyan Kendra, by selecting a sample of 300 from the population of 1,542 women trained under the 5-day and 10-day courses in prawn culture upto March 1985. Information was collected on socio-personal aspects communication pattern, possession of prawn fields and other holdings, live stock and fishery implements, motivation pattern, attitude towards the technology as well as the Krishi Vigyan Kendra, extent of utilization of knowledge and constraints involved.

About 65 per cent of the women trained in the age group of 18-25 had passed middle school. Forty per cent of the families had fishing, 13% had prawn filtration and 15% other fishery related activities as their major source of family income. Among the motivations of taking up the training, economic reasons in terms of getting a job ranked first followed by self achievement and prestige. The training programmes served as an excellent source of information for the prawn farming technology. The trained women had favourable attitude towards the technology as well as the Krishi Vigyan Kendra. The rank order of constraints involved in the utilization of knowledge was financial, non-possession of suitable holdings, short duration of the training course and risk involved in practising the technology.

Study on the training needs of fishery officials of State Government and developmental agencies (FE & E/12.2)

KRISHNA SRINATH

To collect information on organizational set up and development programmes, for the preparation of questionnaire, visits were made to the Departments of Fisheries of Tamil Nadu and Kerala. The construction of questionnaire was completed.

Measurement of level of aspiration of fishermen using projective and non-projective methods (FE & E/12.3)

JANCY JACOB

The major items pertaining to the level of aspiration of fishermen were delineated and ratings were obtained from experts. They were broadly classified as socio-personal and fishery related. Based on this an instrument for data collection was standardised and schedules formed to measure socio-personal characteristics of fishermen. Pre-test of the schedules was over and data collection initiated.

A study on the adoption potentials of integrated fish/prawn farming among the small farmers of selected fishing villages around Cochin, Kerala (FE & E/12.4)

A. REGUNATHAN

During the period under study, developmental agencies were contacted to obtain basic data for identification of villages and target population. An interview schedule was developed to obtain basic and specific information on various physical, economic and socio-psychological characteristics of the target population.

Cost and returns of dolnet fishery in north-west coast (FE&E/13)

D. B. S. SEHARA

Input-output data collected from sample dolnet units at three selected centres were analysed and the results showed that the post-monsoon season contributed 45-49 per cent of the annual catch and 43-45 per cent of gross income. Main constituents of dol catch in north-west coast were non-penaeid prawn, ribbon fish, Bombay-duck and croakers. Initial capital investment was more for the khamba system as compared to sus. The variable cost per operating day ranged from Rs. 324 - 450. For a fishing season of 9 months (Sept. to May) a crew member was paid about Rs. 6000. Labour charges, formed 37-43 per cent of the annual operating expenditure while fuel accounted for 30-36 per cent of the variable cost. Net profit per fishing day ranged from Rs. 75 - 88. The rate of capital turnover was the lowest at Navgaon (68%) and the highest at Madh (102%). Pay back period was found to be about 4 years for sus and 6 years for khamba. Based on economic efficiency parameters, sus system of dol operation was found more economical in the north-west coast.

A diagnostic study of content and coverage of fisheries news in national and regional dailies (FE & S/15)

A. REGUNATHAN

Data were collected from two national and four regional dailies on news items pertaining to fisheries, agriculture and allied fields like veterinary and dairy to compare the coverage, frequency, information sources and message handling by different dailies.

Though different patterns were observed in message handling, no specific pattern and preference was observed for agricultural news. Further, majority of the news items were on the micro level areas of situations and marketing. No reference in placement either in specified pages or in values of upper/lower-half locations in pages was observed. Majority of the news items scored the upper-half location with headlines varying from 4 cm to 26 cm in length and 5-10 mm in width. The length of the news items varied from less than 2 cm to 24 cm.

LIBRARY & DOCUMENTATION DIVISION

Library

During the year, 139 books, 3000 volumes of periodicals and 160 non-book materials were added to the Headquarters Library. The sectoral libraries at the Regional Centre and Research Centres of the Institute also had necessary books added. The inter-library loan, reference facilities and collaboration were provided as usual to visiting students and scientists of various Institutions, Universities, Government Departments etc., inside and outside the country. The Current Awareness Service (Monthly) and the S.D.I. Service (Manual) were continued.

Publications

The following publications were issued by the Institute.

1. Indian Journal of Fisheries Vol. 33. Nos. 1 - 4.
2. Marine Fisheries Information Service : Technical & Extension Series Nos. 63 to 70.
3. CMFRI Special Publication Nos. 24 to 29.
4. CMFRI Newsletter : Nos. 31 to 33
5. CMFRI Bulletin : Nos. 36 to 40.
6. R & D Series (Handouts): Nos. 11 to 13.
7. Research Highlights 1985-86.

POST-GRADUATE EDUCATION AND RESEARCH PROGRAMME IN MARICULTURE

The Post-Graduate Education and Research Programme in Mariculture of the Institute is a continuation of the Centre of Advanced Studies in Mariculture started under FAO/UNDP in 1979. The CAS programme according to the agreement was upto March 1986, but on official arrangement it had another 6 months of phasing out period extending up to September 1986. Sanction was accorded to continue the programme during the VII 5-year plan, under the new name with its expenses from the budget of the Institute.

Ph.D. Programme

Three senior research fellows were awarded Ph.D. Degrees by the Cochin University of Science and Technology for their work on :

1. Studies on sporulation and propagation in selected agarophytes — Shobha P. Shere

2. Studies on the ecology and productivity of saline lagoons -- A. Silas Ebenezar.

3. Pathological investigations in penaeid prawns — Subhash Chandra Soni.

Four senior research fellows submited their theses to the Cochin University of Science and Technology as under :

1. Nutritional studies in juvenile *Penaeus indicus* with reference to protein and vitamin requirements — C. Gopal.

2. Studies on ecophysiology of *Penaeus indicus* H. Milne Edwards in the grow-out systems — Subhash Chander.

3. Studies on histological and biochemical changes during spermatogenesis in *Mugil cephalus* (Linnaeus) and related species — Elizabeth Joseph.

4. Larval biology of the spiny lobsters of the genus *Panulirus* — T. N. Sarasu.

The 7 scholars of the 4th batch completed 3 years of their fellowship period by February/March 1987. All progressed well in their work or preparation of theses. Three Senior Research Fellows of the 5th batch passed the Ph.D. qualifying examination held by the University in January 1987. Ten candidates of the 6th batch joined the course in April, 1986.

M.Sc. Programme

The 5th batch of M.Sc. students completed the course in November,

1986. In the University examination 7 out of the 8 passed in first class. One of the candidates had to get a pass in a paper of the 3rd semester and complete the University examinations. All the 9 students of the 6th batch and 9 students who joined the course on 1-12-1986 in the 7th batch continued their studies.

Consultancies/training

1) Dr. Milton Fingerman, Professor, Department of Biology, Tulane University, New Orleans, U.S.A., was at the Centre to offer consultancy on Fish and Shellfish Endocrinology from 5-6-1986 to 9-7-1986. 2) Dr. D. J. W. Moriarty, Division of Fisheries Research, CSIRO, Australia offered expert consultancy on Microbial Ecology in grow out ponds from 2-8-86 to 16-8-86. Two scientists were deputed for training abroad under the Faculty Improvement Programme.

Workshops conducted

1. Hormone isolation and assay by Dr. M. Fingerman from 25th to 28th of June, 1986.

2. Techniques for estimation of bacterial growth rates and productivity in aquaculture pond systems by Dr. Moriarty from 5th to 9th of August, 1986.

Seminars held

Dr. Fingerman and Dr. Moriarty held 5 and 4 seminars respectively on various topics related to their fields. Shri T. S. Velayudhan, Scientist S-1 on his return from training abroad gave a seminar on molluscan genetics on 21 May 1986. Dr. P. S. Kuriakose, Scientist S-2 on his return from foreign training gave a seminar on mussel culture on 27-11-1986. Shri Syed Ahamed Ali, Scientist S-2 gave a seminar on biochemistry of steroids on 7 Jan. 1987 after his return from training abroad.

Technical reports brought out

1. A Practical Manual for Studies of Environmental Physiology and Biochemistry of Culturable Marine Organisms. CMFRI Special Publication No. 25: 1986 45 pp.

2. Theorems of Environmental Adaptation. CMFRI Special Publication No .26, 1986. 50 pp.

Manuals accepted for publication

1. Nutritive value of live feed organisms and their enrichment.

2. Neuro-endocrine research and techniques.

3. Techniques of estimation of bilateral growth rates and productivity in aquaculture pond system.

KRISHI VIGYAN KENDRA

Dr. M. M. THOMAS (Officer in charge) P. KARUNAKARAN NAIR, K. A. UNNITHAN, Dr. P. K. MARTIN THOMPSON, K. N. R. KARTHA, A. N. MOHANAN, P RADHAKRISHNAN and K. PURUSHOTHAMAN

Courses conducted under KVK, Narakkal

	Subject	Duration (Days)	No. of courses	No. of trainees Male	Female	Total
1.	Prawn/fish culture	5-10	21	141	223	364
2.	Paddy cum fish culture	1	3	30	23	53
3.	Bund construction and sluice fixing	1- 2	2	38	...	38
4.	Eradication of predators	1	1	5	...	5
5.	Prawn and seed collection	1	1	...	20	20
6.	Harvesting, handling, marketing prawn/fish	1	1	11	...	11
7.	Fish processing technology	1- 3	4	...	105	105
8.	Coconut cultivation	1	2	20	...	20
9.	Vegetable cultivation	1	2	...	58	58
10.	Poultry farming	1	3	...	59	59
11.	Duck farming	1	1	...	29	29
12.	Live stock management	1	6	76	44	120
13.	Fruit preservation	1	5	...	111	111
14.	Nutrition	1	2	...	87	87
15.	Social forestry	1	2	...	46	46
16.	Environmental hygiene	1	1	...	17	17
	TOTAL		57	321	822	1143

Survey

Villages of Edacochin, Kumbalam, Poothotta, Tripunithura and Maradu in Ernakulam District were surveyed intensively for identifying farmers and their specific training needs. To identify beneficiaries of the Lab-to-land programme (IV phase) Chattanad, Edavanakad, Nayarambalam, Elamkunnapuzha, and Poothota villages were surveyed. 85 families were selected. Critical inputs such as paddy seed, vegetable seed, fertilizer, prawn and fish seed were supplied. Mini-sluice boxes were also given wherever necessary.

Publication

A revised edition of 'Grow More Prawns' prepared by Shri K. N. R.

Kartha and Shri P. Karunakaran Nair was brought out as Krishi Vigyan Patrika, Mariculture Series 5 (a)

Film shows

62 film shows were arranged on campus and 17 off campus.

Rural forum/Youth club

This was arranged in association with Pandit Karuppan Memorial Arts and Sports Club, Parur, Cochin Samagra, Edacochin and Seven Arts Society, Edavanakkad.

Radio talks

1. 'Importance of scientific prawn farming' by Dr. M. M. Thomas, Scientist S-3. Broadcast over A.I.R. Trichur on 5-2-'87.
2. 'Prawn varieties suitable for scientific prawn farming' by Shri P. Karunakaran Nair, Senior Training Assistant (T-6). Broadcast over A.I.R., Trichur on 26-2-'87.

Exhibitions

The KVK sent exhibits depicting its activities to the Fisheries Exhibition organised in connection with the Central Fisheries Board Meeting at Trivandrum on 26-9-'86. Exhibits were also arranged in connection with the World Food Day at Maliapuram on 26-10-'86, jointly organised by the CIFNET, IFP, CMFRI, CIFT, MATSYAFED, MPEDA and the State Fisheries Department.

Training courses organised under the Trainees Training Centre, Narakkal.

Subject	No. of courses	Duration (days)	Persons trained	Remarks
1. Seaweed culture	1	10	5	Conducted at CMFRI, Mandapam Camp.
2. Prawn farming	2	10	6	Conducted at KVK/ TTC, Narakkal and prawn culture laboratory of CMFRI, Narakkal.
3. Hatchery production of of prawn seed	1	15	5	"
4. Fish processing technology	2	10	5	Conducted at TTC, Narakkal
5. Fishery resources assesment	1	45	13	Conducted at CMFRI, Cochin
6. Sampling techniques in marine fisheries resources assessment	1	15	19	"
7. SCUBA diving	1	60	2	Conducted at CMFRI, Mandapam
TOTAL	9		55	

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